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An Introduction to the Mine Inspection Data Analysis System (MIDAS)

By W. F. Watts, Jr., R. L. Johnson, D. J. Donaven, and D. R. Parker

UNITED STATES DEPARTMENT OF THE INTERIOR

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AN INTRODUCTION TO THE MINE INSPECTION DATA ANALYSIS SYSTEM (MIDAS)

by

W. F. Watts, Jr.,[1] R. L. Johnson,[2] D. J. Donaven,[3] and D. R. Parker[4]

ABSTRACT

This report describes the Mine Inspection Data Analysis System (MIDAS) developed by the Bureau of Mines to analyze the records of industrial hygiene samples collected by the Mine Safety and Health Administration (MSHA) in metal and nonmetal mines. MIDAS is the first system capable of sorting, editing, analyzing, and reporting these data. It is also the first system designed to be used by a number of Government agencies. At present the system contains 225,000 personal and area samples for 61 contaminants in 45 industries. The records date from 1974 to early 1980, and MSHA plans to provide yearly updates to the system. This report presents preliminary analyses of dust exposures and discusses the potential uses and limitations of these data.

Analysis of the dust data for 1978 and 1979 showed that bagging had the highest percentage of dust overexposure. More than 40 pct of the 1,536 respirable quartz dust, total nuisance dust, and total silica dust samples exceeded the MSHA exposure limit. Other dusty occupations are ranked according to their percentage of overexposure.

INTRODUCTION

The Mine Inspection Data Analysis System (MIDAS) developed by the Bureau provides the first systematic, computerized capability to analyze the Mine Safety and Health Administration's (MSHA) inspection data from metal and nonmetal mines and mills. Results from MIDAS are used by the Bureau, MSHA, and the National Institute for Occupational Safety and Health (NIOSH) to plan, rank, evaluate, and conduct their health programs in metal and nonmetal mining. Computer programs contained in MIDAS are designed to edit, sort, analyze,

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and report results as summary tables or graphs, and interactive programing allows flexibility in the types of analyses. For instance, additive exposures are calculated for welders or other miners exposed to more than one contaminant, historical data are analyzed to aid in the selection of mine sites for future work, and problem areas are identified from records of overexposure. The capability to systematically analyze the environmental industrial hygiene data for metal and nonmetal mines did not exist prior to the development of MIDAS.

This report is the first in a series describing MIDAS, its uses, and limitations. Future reports will analyze the large variety of MSHA sampling records, include periodic updating of the data, and exploit the flexibility of the data analysis system. These reports will be organized by contaminant. This report covers the necessary background material and serves as a reference for future reports. It presents preliminary results from the analysis of three major dust contaminants: respirable quartz dust, total nuisance dust, and total silica dust.

In January 1980, the Bureau requested that MSHA make available copies of the computer tapes containing sampling data from metal and nonmetal mine inspections. These tapes along with file layouts, mine directory information, and several COBOL programs were given to the Bureau's data processing center in Denver. An update to this information was received in March 1980. These data, which date from September 1974 through early 1980 and include a total of 144,901 personal samples and 80,087 area samples, are the basis of this report.

CODING SYSTEM FOR SAMPLE COLLECTION

When MSHA inspectors collect personal or area samples, they are required to record additional information about the site; this information and the laboratory results constitute a complete record. About 225,000 records are now stored in MIDAS, and MSHA is adding about 70,000 new records yearly. These records contain about 2.5 million bits of information which MIDAS sorts, analyzes, and reports using the MSHA code categories.

A record of personal exposure contains the following information: contaminant, concentration, threshold limit value (TLV),[5] work location, work operation (occupation), date of collection, mine identification number, personal protection being used, inspector's identification number, and the MSHA subdistrict. MIDAS adds to every record the industry code. MIDAS calculates the concentration-to-TLV ratio (C/TLV) for every record, and for respirable quartz dust and total silica dust MIDAS calculates the percent quartz in the sample. Tables A-1 through A-4 summarize the main MSHA codes for "industry," "location", "operation," and "contaminant" and show the total number of records for each code.

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[5]MSHA has adopted the threshold limit values set forth by the American Conference of Governmental Industrial Hygienists in "TLVs Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH in 1973." Cincinnati, Ohio, 1973, pp. 1-54. The sole exception is asbestos fiber.

Area samples are collected for the contaminants listed in table A-5. Each area record contains information on contaminant, concentration, type of sample, time sampling started and stopped, area of sample collection, mine and inspector identification numbers, and the MSHA subdistrict. Area samples will be discussed further in later reports in this series.

A second source of information in MIDAS is the mine directory, which lists all metal and nonmetal mines and mills inspected by MSHA. Information in this directory is updated annually by MSHA. Each mine or mill listed has an identification number, a company and operation name, a location, the type of mine, the status of the mine (either active, intermittent, or closed), the travel area, the number of employees and a related size code, the date of last regular inspection, the industry, and the State and county. This information is most useful when a mine identification number must be associated with a name and location, or when a list of all mines in a particular industry or region is needed. Unfortunately, data on the number of employees in each occupational category are not available.

The coding system used by MSHA allows MIDAS to analyze and summarize information in a variety of ways, and tables 1 through 3 illustrate this flexibility. Ten contaminants, accounting for 93 pct of the 224,988 samples, are listed in table 1.

TABLE 1. - Ten most frequently sampled contaminants in metal and nonmetal mines, January 1974 through March 1980

Contaminant	Number of samples	Percent of total samples	Type of sample
Noise dosimeter..	73,247	32.6	Personal.
Respirable quartz dust............	42,865	19.0	Do.
Carbon monoxide..	17,223	7.6	Area.
Radon daughter...	15,736	7.0	Do.
Carbon dioxide...	14,582	6.5	Do.
Methane..........	13,431	6.0	Do.
Nuisance dust....	9,814	4.4	Personal.
Oxygen...........	9,435	4.2	Area.
Total silica dust	7,153	3.2	Personal.
Nitrogen dioxide.	6,160	2.7	Area.
Subtotal....	209,646	93.2	
Others...........	15,342	6.8	
Total.......	224,988	100.0	

Table 2 summarizes all respirable quartz dust data for the sandstone industry. The column headings of underground, open pit, sand and gravel, surface, and mill correspond to work location codes 1 to 5, 10 to 12, 13, 20 to 24, and 25, respectively. Different information is obtained by changing the location codes included in each group, restricting the analyses to specific year(s), examining data for a different contaminant, examining data for another industry or group of industries, or using different computer programs to compute different statistics for the same set of data. Table 3 illustrates how the same sandstone respirable quartz dust data appear when summarized by calendar year.

TABLE 2. -Respirable quartz dust data from 1974 through 1980 for the sandstone industry broken down by operation and location[1]

	NAME	UNDERGROUND			OPEN PIT			SAND&GRAVEL			SURFACE			MILL			ALL LOCATIONS		
	OPR.	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV
1	SLUSHG	1	0	0.00	0	0	0.00	1	0	0.00	1	1	100.00	0	0	0.00	3	1	33.33
2	MCHMCK	1	0	0.00	2	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	0	0.00
3	HANMCK	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
4	TIMBER	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
5	RCKBLT	1	1	100.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	100.00
6	BCKFIL	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
7	BLASTG	1	0	0.00	1	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	3	0	0.00
8	RCKSAW	0	0	0.00	2	0	0.00	0	0	0.00	5	0	0.00	21	1	4.76	28	1	3.57
9	DRLPER	3	2	66.67	74	21	28.38	0	0	0.00	2	0	0.00	1	0	0.00	80	23	28.75
10	DRLROT	1	0	0.00	22	9	40.91	3	0	0.00	5	1	20.00	1	0	0.00	32	10	31.25
11	DRLDIA	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	100.00	1	1	100.00
12	LHDELC	1	0	0.00	17	2	11.76	4	3	75.00	14	5	35.71	22	10	45.45	58	20	34.48
13	LHDDIE	16	5	31.25	404	60	14.85	59	8	13.56	43	6	13.95	11	2	18.18	533	81	15.20
14	LHDGAS	4	1	25.00	7	3	42.86	0	0	0.00	1	0	0.00	3	1	33.33	15	5	33.33
15	LHDAIR	1	1	100.00	2	1	50.00	0	0	0.00	2	0	0.00	3	2	66.67	8	4	50.00
16	MINMCH	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00	1	0	0.00
17	TRKCRW	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
18	CMPCYC	0	0	0.00	11	0	0.00	1	0	0.00	1	0	0.00	1	1	100.00	14	1	7.14
19	CONCRE	0	0	0.00	3	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	3	0	0.00
20	HOISTG	0	0	0.00	4	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	0	0.00
21	BULLDZ	0	0	0.00	25	9	36.00	1	0	0.00	0	0	0.00	1	1	100.00	27	10	37.04
22	SLURRY	3	0	0.00	0	0	0.00	0	0	0.00	3	1	33.33	0	0	0.00	6	1	16.67
23	GLCLUP	2	0	0.00	56	16	28.57	8	1	12.50	100	54	54.00	38	22	57.89	204	93	45.59
24	GSHPWK	2	0	0.00	6	2	33.33	0	0	0.00	6	0	0.00	6	0	0.00	20	2	10.00
25	WLDING	0	0	0.00	2	0	0.00	1	0	0.00	3	0	0.00	1	0	0.00	7	0	0.00
26	MECHAN	4	0	0.00	10	3	30.00	1	0	0.00	23	4	17.39	10	1	10.00	48	8	16.67
27	CRUSHG	0	0	0.00	138	58	42.03	15	2	13.33	176	70	39.77	12	5	41.67	341	135	39.59
28	GRINDG	1	1	100.00	13	5	38.46	1	1	100.00	39	20	51.28	30	19	63.33	84	46	54.76
29	RSTRTG	0	0	0.00	0	0	0.00	2	0	0.00	4	3	75.00	13	5	38.46	19	8	42.11
30	DYFLTH	11	4	36.36	17	6	35.29	7	3	42.86	48	14	29.17	109	35	32.11	192	62	32.29
31	SIZING	1	1	100.00	54	14	25.93	18	8	44.44	31	7	22.58	89	38	42.70	193	68	35.23
32	CNCTRG	0	0	0.00	0	0	0.00	0	0	0.00	36	30	83.33	4	0	0.00	40	30	75.00
33	CHEMOP	0	0	0.00	0	0	0.00	0	0	0.00	3	0	0.00	0	0	0.00	3	0	0.00
34	SUPPLY	0	0	0.00	0	0	0.00	4	2	50.00	8	3	37.50	22	9	40.91	34	14	41.18
35	TCHSRV	2	1	50.00	5	1	20.00	0	0	0.00	3	0	0.00	5	1	20.00	15	3	20.00
36	ADMINS	0	0	0.00	11	1	9.09	1	0	0.00	14	4	28.57	5	2	40.00	31	7	22.58
37	BAGGER	2	1	50.00	11	8	72.73	9	5	55.56	5	0	0.00	226	134	59.29	253	148	58.50
38	PELLET	0	0	0.00	0	0	0.00	0	0	0.00	3	2	66.67	0	0	0.00	3	2	66.67
39	DREDGE	0	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	1	0	0.00
40	JETPRC	0	0	0.00	1	1	100.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	100.00
	TOTAL	58	18	31.03	898	220	24.50	136	33	24.26	581	225	38.73	636	290	45.60	2309	786	34.04

1 The column headings are the number of samples, the number of samples with concentrations greater than or equal to the TLV (GETLV), and the percent of samples with concentrations greater than or equal to the TLV.

TABLE 3. - Sandstone respirable quartz dust data summarized by year

	1974	1975	1976	1977	1978	1979	1980
Number of samples	57	226	359	629	421	611	6
Number of samples greater than or equal to TLV (GETLV)	49	94	150	195	136	160	2
Percent of samples GETLV	85.96	41.59	41.78	31.00	32.30	26.19	33.33
Number of samples greater than or equal to 1.2 times the TLV[1]	44	85	125	167	112	127	1
Percent of samples greater than or equal to 1.2 times the TLV	77.19	37.61	34.82	26.55	26.60	20.79	16.67
Average concentration mg/m^3	0.62	0.75	0.97	1.38	0.49	0.86	0.32
Minimum concentration mg/m^3	0.05	0.01	0.02	0.00	0.01	0.00	0.16
Maximum concentration mg/m^3	3.00	15.50	51.00	386.00	7.90	63.33	0.56
Standard deviation of the concentration	0.55	1.34	3.47	15.88	0.77	3.59	0.15
Variance of the concentration	0.30	1.78	12.04	252.17	0.60	12.86	0.02
T-statistic (calculated between years)	0.000	-0.706	-0.917	-0.481	1.53	-2.070	0.366
Average concentration-TLV ratio	4.00	2.90	3.23	3.67	1.25	2.52	0.84
Minimum SiO_2 (calculated) percent	9.11	1.10	1.13	1.00	1.00	1.00	9.24
Maximum SiO_2 (calculated) do	98.00	98.00	74.92	98.00	98.00	98.00	39.67
Average SiO_2 (calculated) do	48.35	25.60	22.63	20.26	23.71	18.47	21.12
Sum of the concentrations	35.52	169.67	348.96	868.69	205.51	522.82	1.92
Sum of the concentrations squared	38.82	528.71	4,648.63	159,562.49	350.72	8,293.26	0.73
Median concentration mg/m^3	0.52	0.37	0.35	0.30	0.30	0.30	0.30

[1]This is MSHA's action level.

The organization of data and the selection of the computer program are options which MIDAS gives to the user. If the initial choice of data or program does not clearly answer the question, further analysis is possible.

APPROACH

The MSHA sampling data constitute the largest and most comprehensive set of environmental industrial hygiene data available from noncoal mines, but no system was previously available for data manipulation, analysis, and reporting. The Bureau with cooperation from MSHA developed MIDAS to solve this problem. The data reduction and reporting programs in MIDAS reflect the priorities established by the Bureau and MSHA, and they will be further developed to reflect the changing needs of the Bureau, MSHA, and other agencies. A complete description of these programs is found in the User's Manual.[6]

The conceptual approach of MIDAS was to start with the entire data set and count the number of records within the code categories as shown in the tables A-1 to A-5. Once knowledge was gained about the number of records in these categories, decisions were made on how to edit records for particular contaminants, and priorities were assigned for the depth and sequence of analysis for each contaminant. Among the personal samples, dust, noise, and welding fumes received the highest priority, based upon the perceived health risks and the large body of records available.

Two fundamental approaches to data analysis are available within MIDAS. The first involves starting with a large set of data and reducing it to smaller and smaller subsets. This step-by-step analysis produces a series of results that document contaminant levels found in industries and operations (occupations). Examination of data by calendar year allows trends in concentrations and overexposures to be recognized within industries and occupations. The second approach identifies a particular mine, operation, industry, or other variable and selects individual records for analysis. MIDAS will select records, create a data file, and summarize the findings using the computer programs chosen by the investigator. Each of these approaches has been used to produce reports for investigators in the Bureau, MSHA, and NIOSH. However, there exists a limit to the conclusions that can be drawn from the available data.

Limitations and Uses

The Federal Mine Safety and Health Act of 1977 (Public Law 91-173) requires MSHA to enforce the safety and health regulations specified in the Code of Federal Regulations for coal and noncoal mines.[7]

To insure compliance, samples are collected during mine inspections. The method in which miners are selected for sampling presents a statistical

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[6]Jahsman, W. E., R. L. Johnson, D. J. Donaven, and W. F. Watts. MIDAS User's Manual, 1981. Available from Division of Automatic Data Processing, Bureau of Mines, Denver, Colo. 80225.

[7]U.S. Congress. The Federal Mine Safety and Health Act of 1977. Public Law 91-173, as amended by Public Law 95-164, 83 Stat. 803.

problem, because the sampling strategy is judgmental and depends upon the MSHA inspector. MSHA inspectors are instructed to sample employees known or suspected to be at highest risk within each occupational category. Even more important, occupations and locations where overexposures occur are resampled, often several times, whereas other occupations and locations may not be sampled as often. However, it cannot be concluded that the data are systematically biased upward; in fact, the degree and direction of the bias is unknown, and therefore assessment of the sampling error is difficult, since the sample may not reflect the whole population. Two mitigating factors are that (1) certain operations and locations are sampled so heavily that MSHA has a census and (2) MSHA inspectors, using common sense and judgment, have attempted to take "representative" samples within each occupation and location at each mine or mill.

An example of MSHA sampling strategy is the loading, hauling, dumping, diesel occupation which was sampled 44,719 times for all contaminants (table A-3). Further breakdown shows that 9,490 of these were respirable quartz dust samples, which had 8.19 pct overexposures (table A-17), and an additional 10,576 noise dosimeter samples were collected on these operators with 41-pct overexposure. Clearly MSHA inspectors simultaneously sample load-haul-dump diesel operators for dust and noise. This is further shown by matching load-haul-dump diesel operators' social security numbers with dates of sample collection for these contaminants. This information is available in MIDAS.

The result of a nonrandom sampling strategy is that statistical inferences based on models assuming randomness, known distribution, or homogeneity of variance must be made with caution. This report does not rely heavily upon statistical tests, although they are available in MIDAS; instead this report relies upon basic descriptive statistics to determine the trends in the MSHA dust data. A search is underway to identify a set of randomly collected dust data to act as a control for comparison with a matched set of randomly selected data from MIDAS. Such analysis may indicate the nature and direction of the bias in the MSHA data.

Pinpointing the precise nature of a problem is limited to the information contained in the sample record. Thus, although these data indicate that bagging had the greatest percentage of overexposure in 1978 and 1979, they do not identify the exact cause of the problem, because of the generalized coding system and because personal exposure samples are collected on miners who move freely within the mine or mill. No indication of the characteristics of the material being bagged are given in the MSHA record, nor is there a description of the type of equipment.

Another limiting factor is the variability in the number of samples collected for a given contaminant within a particular industry or operation. As shown in tables A-1 through A-4, the code categories have a wide range of personal exposure samples available for analysis. The diesel load-haul-dump operation in table A-3 has nearly 45,000 records of personal exposure, whereas backfilling has only 28 records. A likely explanation for this difference is that backfilling is rarely practiced in underground metal and nonmetal mines, whereas operating diesel-powered load-haul-dump vehicles is common in all types of mining and is therefore heavily sampled. Similarly,

some contaminants are rarely sampled while others are sampled often, reflecting their relative pervasiveness and MSHA's priorities.

MIDAS provides exact knowledge of what data are available, and its most obvious application is to help MSHA evaluate and plan its metal and nonmetal inspection program. Knowledge of past contaminant trends allows it to emphasize certain areas. NIOSH and the Bureau have a convenient system for analyzing retrospectively this large body of data. Knowledge derived from this analysis will allow researchers in both agencies to better plan, explain, conduct, and evaluate future research projects.

Data Editing

All dust and fiber records contained in MIDAS have been edited for obvious errors using the threshold limit value (TLV) as the reference. The TLV's for respirable quartz dust and total silica dust are determined by the formulas given below, and illustrate the reasoning behind the edit format.

TLV for respirable quartz dust in mg/m^3 is

$$\frac{10\ \mathrm{mg/m^3}}{\text{pct respirable quartz} + 2},$$

and TLV for total silica dust in mg/m^3 is

$$\frac{30\ \mathrm{mg/m^3}}{\text{pct quartz} + 3},$$

where the quartz content is greater than or equal to 1 pct. By substitution it can be determined that the TLV for respirable quartz dust must be between 0.10 mg/m^3 and 3.33 mg/m^3, and that the TLV for total silica dust must be between 0.29 mg/m^3 and 7.50 mg/m^3. These values are derived by substituting 1.0 pct and 100 pct for the percent quartz in the formulas. When a TLV fell within these ranges, the record was considered acceptable; a TLV figure outside these ranges required an alternative explanation. The inspector has one code each for respirable quartz dust, tridymite, and cristobalite regardless of quartz content, so MIDAS created a code for respirable nuisance dust when the TLV listed for these contaminants indicated less than 1 pct quartz. Two codes are available for total dust samples, one for silica dust and one for nuisance dust. MSHA inspectors sometimes confuse these codes, so MIDAS correctly reclassified these records based upon the TLV.

Other common errors were recording the action level[8] rather than the TLV, failure to record a new TLV after it changed, misplaced decimals, or missing TLV. The edit program did not change the concentration reported for any of the eight dust contaminants, and excessively high concentrations are being checked for possible editing. Table 4 outlines the editing rules for the dust contaminants, and table 5 summarizes the effects of editing the records.

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[8]The action level is defined as the exposure limit plus a 20-pct factor for dust-sampling error.

TABLE 4. - Editing rules for MSHA dust data

Respirable quartz dust, mg/m^3:	
$0.10 \le TLV \le 3.33$	Data OK.
$3.34 \le TLV \le 5.00$	Change code to 02 (respirable nuisance dust); change TLV to 5.0.
TLV = 6	Change code to 02; change TLV to 5.0.
$5 < TLV < 6$	Change code to 34 (total silica dust).
$6 < TLV \le 7.5$	Change code to 34.
$TLV < 7.5 \geq 10$	Change code to 04 (total nuisance dust); change TLV to 10.
Reject other values.	
Talc, mppcf (million particles per cubic foot of air):	
TLV = 20,40	Data OK.
Reject other values.	
Nuisance dust, mg/m^3:	
TLV = 10	Data OK.
TLV = 12	Change TLV to 10.
$0.29 \le TLV \le 7.50$	Change code to 34.
$7.51 \le TLV \le 9.99$	Change TLV to 10.
Reject other values.	
Cristobalite, mg/m^3:	
$0.05 \le TLV \le 1.67$	Data OK.
$1.68 \le TLV \le 2.5$	Change to code 02; change TLV to 5.
Reject other values.	
Tridymite, mg/m^3:	
$0.05 \le TLV \le 1.67$	Data OK.
$1.68 \le TLV \le 2.5$	Change code to 02; change TLV to 5.
Reject other values.	
Asbestos, $fibers/cm^3$:	
1974 to 1978:	
TLV = 5,10	Data OK.
TLV = 6	Change TLV to 5.
1979 to present:	
TLV = 2,10	Data OK.
Reject other values.	
Total silica dust, mg/m^3:	
$0.29 \le TLV \le 7.50$	Data OK.
$7.51 \le TLV \le 10.00$	Change code to 04; change TLV to 10.
TLV = 12	Change code to 04; change TLV to 10.
Reject other values.	

NOTE.--Code 02 was created during the edit for respirable nuisance dust. The second TLV listed for talc and asbestos is for short-term samples.

TABLE 5. - Effect of editing contaminant records

Contaminant	Number of records before edit	Number of records after edit	Change, pct
Respirable quartz..........	42,865	33,260	22.41
Respirable nuisance dust...	0	7,904	-
Talc fiber.................	195	183	6.15
Total nuisance dust........	9,814	8,874	9.58
Cristobalite...............	134	117	12.69
Tridymite..................	7	3	57.14
Asbestos fiber.............	842	828	1.66
Total silica dust..........	7,153	8,163	-14.11
Total.................	61,010	59,332	2.75

NOTE.--Respirable nuisance dust was created during the edit of contaminants 01, 11, and 12 (respirable quartz dust, cristobalite, and tridymite).

The total effect of editing was to reduce the number of records by 2.75 pct and to alter the TLV and/or the contaminant code in about 18 pct of the records.

Statistical Programs

MIDAS programs are completely described in the User's Manual. These programs, which provide basic descriptive statistics that summarize the data file created by the user, include the following parameters: Mean, median, range, standard deviation, variance, the number and percent of samples where the concentration equals or exceeds the TLV, and the number and percent of samples where the concentration exceeds the TLV by 1.2 or more. Other programs provide cumulative frequency distributions for concentration and the concentration-TLV ratio. MIDAS has access to the Biomedical Series of programs developed at UCLA, which include graphics and higher level statistical programs such as regression analysis.[9]

INITIAL RESULTS OF DUST ANALYSIS

Summaries for respirable quartz dust, total nuisance dust, asbestos fiber, and total silica dust appear in table 6. During 1975-79 the respirable dust category exhibited a drop from 28.34 to 14.09 pct in the proportion of samples that were greater than or equal to the TLV (GETLV). The same downward trend is observed for the other contaminants with the exception of asbestos, which had fewer samples collected and whose TLV was lowered in 1979 from 5 fibers/cm^3 to 2 fibers/cm^3. The average concentration figures, especially for nuisance dust and asbestos fiber, fluctuate from year to year owing to a few exceptionally high concentrations, as reflected in the high standard deviations.

[9]Dixon, W. J., and M. B. Brown (eds). BMDP-79 Biomedical Computer Programs P-Series. University of California Press, Los Angeles, Calif., 1979, 880 pp.

TABLE 6. - Summary statistics for respirable quartz dust, total nuisance dust, asbestos fiber, and total silica dust

Year[1]	Total samples	GETLV, pct	1.2×TLV,[2] pct	Concentration: Average	Concentration: Median	Concentration: Standard deviation	Average C/TLV[3]	Average silica, pct
RESPIRABLE QUARTZ DUST								
1974..	335	48.66	42.69	0.92	0.54	1.08	1.88	20.99
1975..	2,710	28.34	23.95	.93	.47	1.79	1.31	12.53
1976..	6,314	25.75	21.30	1.08	.48	5.10	1.32	9.93
1977..	7,745	19.47	15.73	.98	.43	6.05	1.17	9.51
1978..	8,285	16.37	13.20	.83	.38	2.27	.84	9.81
1979..	7,779	14.09	11.17	.93	.34	4.61	1.11	9.09
1980..	92	43.48	35.87	.80	.58	.72	1.35	16.08
TOTAL NUISANCE DUST								
1974..	71	23.94	14.08	8.23	4.14	13.84	0.82	NAp
1975..	473	37.84	33.62	16.61	6.56	26.40	1.66	NAp
1976..	1,313	31.23	27.57	12.72	4.37	23.70	1.27	NAp
1977..	1,615	33.99	29.60	13.83	5.64	28.40	1.38	NAp
1978..	2,181	24.94	21.23	10.22	4.08	20.85	1.02	NAp
1979..	3,150	20.48	16.76	8.18	3.02	21.66	.82	NAp
1980..	71	14.08	12.68	11.53	.22	51.40	1.15	NAp
ASBESTOS FIBER								
1974..	14	42.86	42.86	33.18	3.87	53.50	6.64	NAp
1975..	114	2.63	2.63	1.37	.88	1.93	.27	NAp
1976..	241	8.30	7.47	2.09	.70	3.82	.42	NAp
1977..	165	5.45	4.24	1.03	.30	1.89	.19	NAp
1978..	68	2.94	1.47	1.07	.62	1.26	.21	NAp
1979..	221	13.57	9.50	1.04	.44	1.70	.52	NAp
1980..	5	60.00	40.00	2.28	2.20	.53	1.14	NAp
TOTAL SILICA DUST								
1974..	34	41.18	29.41	4.73	1.65	7.40	1.60	13.57
1975..	197	67.01	62.44	15.49	8.28	23.93	3.74	5.60
1976..	785	42.29	36.69	7.88	3.13	15.42	1.98	5.62
1977..	1,640	39.02	35.42	8.68	2.69	23.00	2.68	6.10
1978..	1,757	21.86	18.50	4.67	1.45	12.70	1.39	6.40
1979..	3,725	19.89	16.21	3.73	1.31	9.58	1.04	6.87
1980..	25	32.00	28.00	5.79	1.99	8.09	1.08	3.08

NAp Not applicable.
[1]Data recorded for 1975-1979 are complete; those for 1974 and 1980 represent only a small segment of the year.
[2]Percent of records with concentrations exceeding the TLV by 20 pct.
[3]Average concentration-to-TLV ratio.

Dust data generally follow a log normal distribution, and the MSHA data are no exception. Figures A-1 to A-6 show the effect of a logarithmic transformation on respirable quartz, total nuisance, and total silica dust. In each case the transformed data are a straight line with the exception of the upper and lower tails, which remain slightly skewed. The transformations reveal the underlying normal distribution and lessen the effects of the extremes upon the mean, standard deviation, and variance.

The yearly respirable quartz dust data, broken down by industry and location, are shown in tables A-6 to A-10; table A-11 shows the totals for all data between 1974 and 1980. These tables show the percentage of overexposures for respirable quartz dust in the metal nonmetal industries; for example, for 1979 (table A-10) samples from surface mills have 26.46 pct GETLV and sandstone (38.37 pct), clay and shale (31.84 pct), sand and gravel (31.69 pct), and other nonmetals (76.19 pct) account for a major share of those overexposures. These industries accounted for 641 of 1,266 samples collected in 1979, and 243 of those samples (37.91 pct) equaled or exceeded the TLV. Referring back to table 2, which summarizes all respirable quartz data for sandstone by operation and location, many operations in the mill are very dusty, most notable bagging and sizing. It is possible to break table 2 down by years or groups of years, but this involves fewer samples in each category and makes the information less reliable. However, individual sample records can be checked with respect to specific mills; MIDAS allows this precision.

Yearly summaries of respirable quartz dust by operation and location are in tables A-12 to A-17. Table 7 ranks the dustier operations and is based upon data in tables A-15 and A-16. MIDAS will provide similar analyses for any contaminant. Tables 8 and 9 rank the dusty operations according to overexposure to total nuisance and total silica dust. Of the 40 MSHA occupation codes, baggers have the greatest percentage of overexposure with over 40 pct (GETLV) of the 1,536 samples for samples collected in 1978-79. The other seven occupations ranked in table 7 also appear in tables 8 and 9, showing that they are consistently dusty regardless of contaminant sampled.

TABLE 7. - MSHA respirable quartz dust samples for 1978-79 for eight dusty operations

Operation	1978		1979	
	Number of samples	GETLV, pct	Number of samples	GETLV, pct
Bagger	301	41.86	302	41.72
General labor	760	25.92	867	23.07
Grinding	284	25.00	155	18.71
Drying, filtering, and thickening	202	21.29	220	16.82
Percussive drilling	438	21.23	295	22.37
Crushing	1,357	20.78	1,392	17.60
Sizing	319	17.55	299	17.39
Rotary drilling	166	17.47	183	19.67
Total or average, all operations	8,285	16.37	7,779	14.09

TABLE 8. - MSHA nuisance dust samples for 1978-79 for 12 dusty operations

Operation	1978		1979	
	Number of samples	GETLV, pct	Number of samples	GETLV, pct
Bagger................................	245	46.53	429	40.33
Sizing................................	118	45.76	92	33.70
Rotary driller........................	86	38.37	83	24.10
Grinding..............................	145	37.93	126	25.40
Mining machine operator...............	40	35.00	30	60.00
Drying, filtering, and thickening......	96	29.17	171	19.88
General labor.........................	274	27.01	366	31.69
Loading, hauling, and dumping--electric	62	22.58	81	17.28
Percussive drilling...................	52	21.15	129	15.50
Supply handling.......................	64	17.19	66	24.24
Mechanic..............................	91	15.38	79	22.78
Crushing..............................	157	14.01	339	18.88
Total or average, all operations..	2,181	24.94	3,150	20.48

TABLE 9. - MSHA total silica dust samples for 1978-79 for nine dusty operations

Operation	1978		1979	
	Number of samples	GETLV, pct	Number of samples	GETLV, pct
Bagger................................	106	50.00	153	54.90
Grinding..............................	55	41.82	64	34.38
Rotary drilling.......................	45	35.56	75	37.33
General labor.........................	138	28.26	324	24.38
Drying, filtering, and thickening.....	33	27.27	57	24.56
Percussive drilling...................	60	26.67	125	21.60
Crushing..............................	244	25.00	635	28.50
Mechanic..............................	75	22.67	68	23.53
Sizing................................	58	21.86	138	35.51
Total or average, all operations.	1,757	21.86	3,725	19.89

This brief analysis demonstrates how MIDAS can rank occupations for dust overexposure and identify the industries where they are most likely to occur. MSHA inspectors are finding a lower percentage of overexposures, and bagging, grinding, and general labor cleanup operations are more likely to have concentrations that exceed the exposure limit. Research is underway to determine if the reduction in the percentage of overexposures is a real difference due to lower dust levels or is merely due to alterations in inspectors' sampling strategy. Preliminary statistical evidence suggests that sampling strategy is not responsible for the reduction.

MIDAS is programed to calculate cumulative frequency distributions for concentration and the concentration-to-TLV ratio. Figures 1 and 2 show log probability plots for the cumulative frequencies of the three dust contaminants most often sampled. Concentrations for respirable quartz dust are lower than those for the other two, because collection of respirable quartz

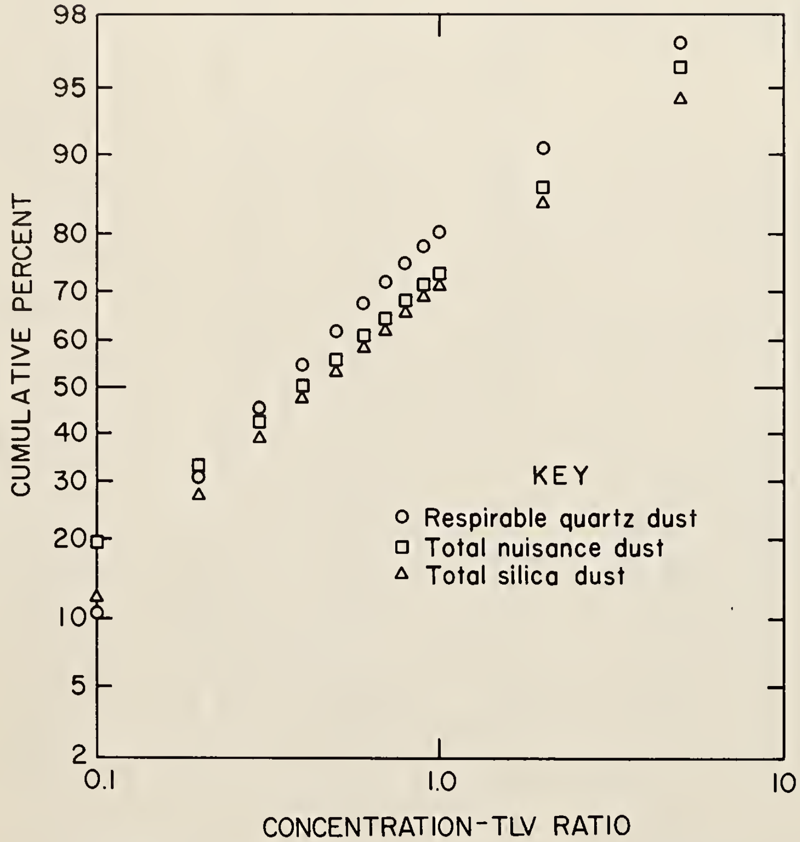

FIGURE 1. - Log probability plot of the concentration-TLV ratios for MSHA data, 1974-80.

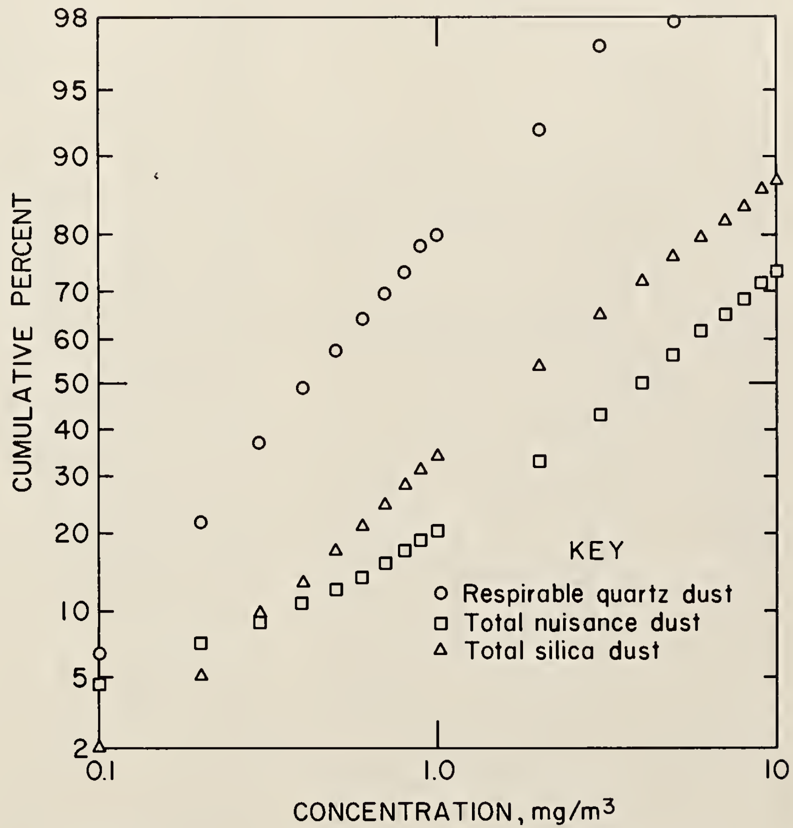

FIGURE 2. - Log probability plot of concentrations for MSHA data, 1974-80.

dust requires a cyclone preseparator to remove large particles from the airstream before it reaches the filter. This is particularly evident in figure 2, where about 80 pct of the respirable quartz dust samples have concentrations of 1.0 mg/m^3 or less, as opposed to far lower percentages for total nuisance and total silica dust. That figure also shows an interesting difference in the distribution of total silica and total nuisance dust concentrations. A sample containing less than 1 pct silica is classified as nuisance dust, while one with more than 1 pct is classified as total silica dust. Fifty percent of the total silica dust concentrations are greater than 1.1 mg/m^3, whereas 70 pct of the total nuisance dust concentrations are above that level. Further analysis of the nuisance dust concentrations shows that MSHA collected 8,874 samples from 1974 through 1980, with 2,354 (26.53 pct) exceeding the 10 mg/m^3 TLV. Three industries, salt, potash, and cement, accounted for 923 (39 pct) of all nuisance dust overexposures. None of these industries uses substantial amounts of water to control dust because the product is water soluble. Furthermore, MSHA has a policy of emphasizing dust control in mines and mills known to have silica dust. These two factors may account for the lower total silica dust concentrations. Table 6 shows the yearly average concentration for both contaminants, and for each year the average concentration for total nuisance dust is higher.

Fewer respirable quartz dust samples exceeded the TLV in 1979 than in 1975-76. In 1979 approximately 12 pct more samples had a concentration-TLV ratio of 1.0 or less when compared with 1975-76 data (fig. 3). T-test results on the log means for the two sets of data in figure 4 were significantly different ($p = 0.001$). On the other hand 14 pct of the 1979 samples still had concentrations at or above the TLV (fig. 4). More than 21 pct of the nuisance dust samples collected in 1979 had concentrations GETLV of 10 mg/m^3 (fig. 5).

Table 10 summarizes employment figures for the 20 largest metal and nonmetal industries and shows the percentage of workers employed in underground mines, sand and gravel operations, stone quarries, open pits, and mills. It also helps determine which industries are dustier than others. Industries with 30 pct or more of their dust samples at or above the TLV include potash (50.65 pct), salt (40.35 pct), other nonmetals (35.48 pct), sandstone (31.64 pct), molybdenum (31.17 pct), and clay and shale (30.41 pct). These are well above the 6-year industry average of 19.59 pct (table 10).

TABLE 10. - Top 20 metal and nonmetal (MNM) industries by active employment[1]

Industry	Total active employment	Total[2] dust samples	Ratio number of samples to employment	Samples for dust, pct	Outliers[3] for dust, pct	Samples GETLV, pct	Employment by active mine type, pct				
							Underground mines	Sand and gravel quarries	Stone mines	Open pit mines	Mill[4]
Limestone..........	36,501	14,935	0.41	25.2	19.9	13.19	8.6	0	85.9	0	5.4
Copper.............	29,179	2,494	.08	4.2	1.1	19.17	25.7	0	0	45.7	26.8
Sand and gravel....	28,055	6,990	.25	11.8	3.0	14.99	.05	98.2	0	0	1.7
Cement.............	25,734	5,358	.21	9.0	13.8	21.80	.7	0	43.6	0	55.8
Iron...............	22,316	2,232	.10	3.8	.2	16.44	4.3	0	0	68.9	26.8
Uranium............	16,030	1,531	.10	2.6	0	7.97	41.5	0	0	34.3	24.1
Clay and shale.....	10,875	3,785	.35	6.4	3.8	30.41	1.5	0	0	62.8	35.8
Phosphate..........	8,561	630	.07	1.1	1.1	18.57	1.2	0	0	86.5	12.4
Granite............	7,158	3,024	.42	5.1	2.5	19.28	0	0	95.4	0	3.6
Bauxite............	6,970	257	.04	.4	1.1	27.24	0	0	0	3.9	96.1
Lead and zinc......	6,284	1,346	.21	2.3	.4	13.60	95.7	0	0	.2	4.1
Gold and silver....	5,568	1,043	.19	1.8	.2	14.19	71.1	0	0	19.5	9.4
Lime...............	4,860	1,401	.29	2.4	2.8	16.27	7.2	0	64.5	0	28.2
Molybdenum.........	4,687	616	.13	1.0	0	31.17	64.9	0	0	21.2	13.9
Sodium.............	4,221	388	.09	.7	2.1	29.90	99.1	0	0	.4	.4
Salt...............	3,994	917	.23	1.5	17.4	40.35	75.4	0	0	10.5	14.1
Sandstone..........	3,804	2,614	.69	4.4	1.1	31.64	2.5	0	91.1	0	5.3
Other nonmetal.....	3,454	1,150	.33	1.9	1.7	35.48	13.7	0	0	54.8	31.6
Traprock...........	3,196	961	.30	1.6	1.0	14.15	0	0	99.5	0	.5
Potash.............	2,792	310	.11	.5	4.5	50.65	88.6	0	0	6.1	5.3
Total or average......	234,239	51,982	.22	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp
Percent of total MNM....	94.0	87.6	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp	NAp
Total or average, all MNM.	249,176	59,332	.24	NAp	NAp	19.59	NAp	NAp	NAp	NAp	NAp

NAp Not applicable.
[1]Approximate employment data as of June 1980.
[2]Dust samples include all respirable quartz dust, respirable nuisance dust, talc, total nuisance dust, cristobalite, tridymite, asbestos, and total silica.
[3]Outlier defined as any value $\geq$ 50 mg/m^3; there were 528 outliers (0.8 pct).
[4]These mills have their own mine identification number.

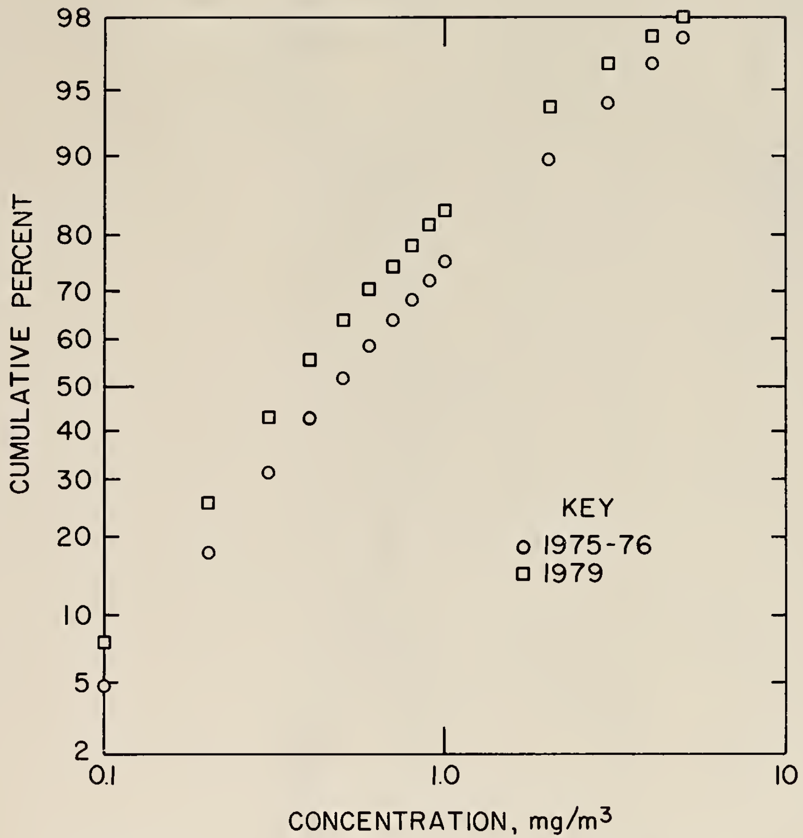

FIGURE 3. - Log probability plot for respirable quartz dust for 1975-76 and 1979.

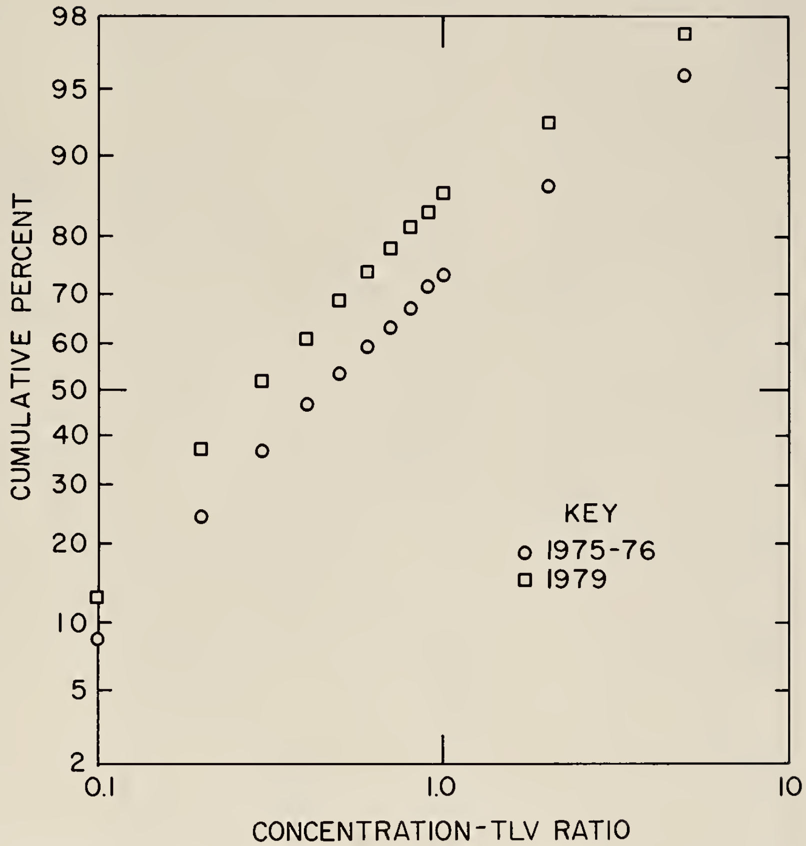

FIGURE 4. - Log probability plot for respirable quartz dust concentration-TLV ratios for 1975-76 and 1979.

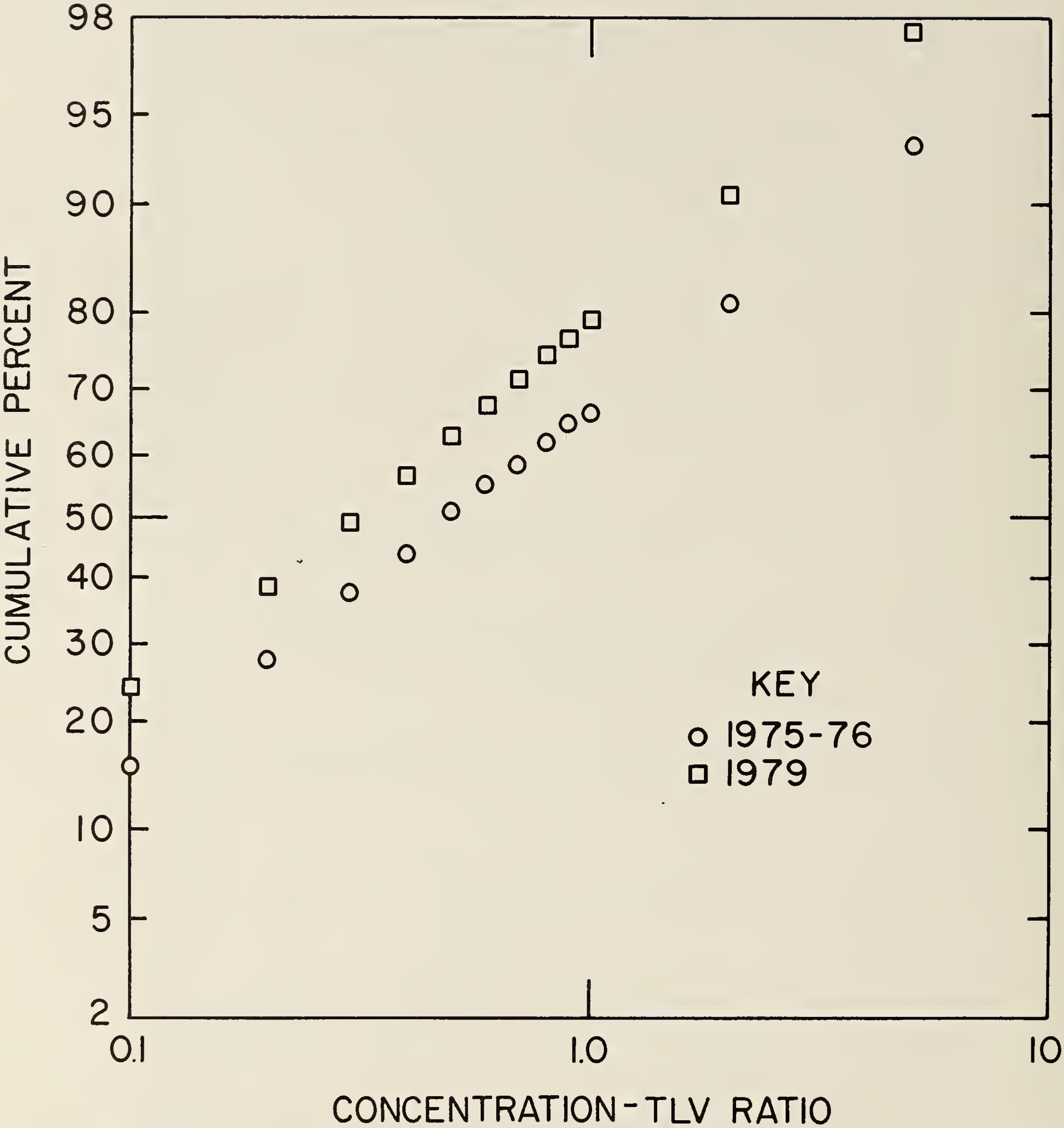

FIGURE 5. - Log probability plot for total nuisance dust concentration-TLV ratios for 1975-76 and 1979.

Examination of outlier values arbitrarily defined as concentrations ≥ 50 mg/m^3 (table 10) has shown them not to be randomly distributed. Interestingly, the industries with the worst nuisance dust problems, salt, cement, and potash, account for a far higher percent of the outliers than would be expected from their share of the total samples. Salt accounts for 1.5 pct of the samples but 17.4 pct of the outliers, cement for 9 pct of the samples but 13.8 pct of the outliers, and potash for 0.5 pct of the samples but 4.5 pct of the outliers. In this instance, examination of outlier values would have identified three of the dustier industries.

MIDAS has provided reports to a number of agencies, including MSHA and NIOSH, and to private consultants and industry representatives. MIDAS summarized the records collected on welders and calculated the additive exposure for welders. MIDAS analyzed samples of lead exposure and provided a summary, which was used as background for congressional testimony on proposed changes to the lead standard. Similar summary analyses were done for asbestos fiber, respirable quartz dust, total silica dust, and noise. However, the system's full potential has not been exploited. It is possible for many people to gain direct access to MIDAS and use the system with a minimum amount of training. Such activity would greatly expand the value of MIDAS by addressing a wide variety of questions at the same time. Utilizing MIDAS in this way would fulfill the system's potential. Multiple use is easily established at low cost.

SUMMARY

The Mine Inspection Data Analysis System (MIDAS) has been developed to sort, analyze, summarize, and report MSHA sampling data for metal and nonmetal health samples. Information provided by MIDAS can assist to plan, rank, evaluate, and conduct health research projects. The system contains the single largest source of industrial hygiene data for noncoal mining.

Results indicate that certain mining operations are dustier than others and that the three dustiest are bagging, grinding, and general labor cleanup. Six industries are substantially dustier than the others: sandstone, molybdenum, salt, potash, clay and shale, and other nonmetals. Operations conducted in a mill or surface plant are likely to be dustier than operations conducted in underground or open pit mines.

MIDAS can be used directly by many agencies, consultants, or operators, and it is hoped that such direct access will be realized in the future.

APPENDIX

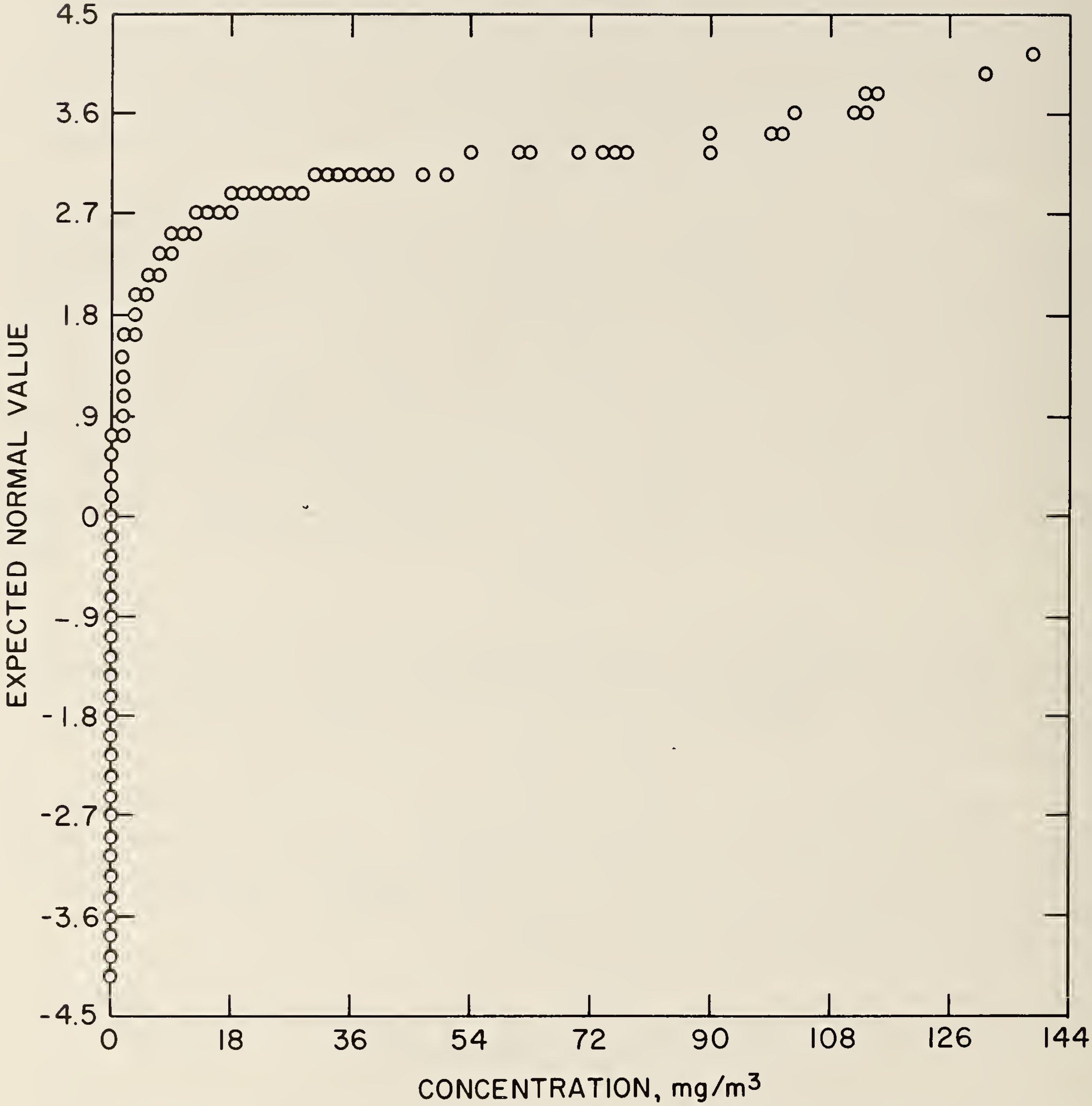

FIGURE A-1. - Probability plot of respirable quartz dust data, 1974-80.

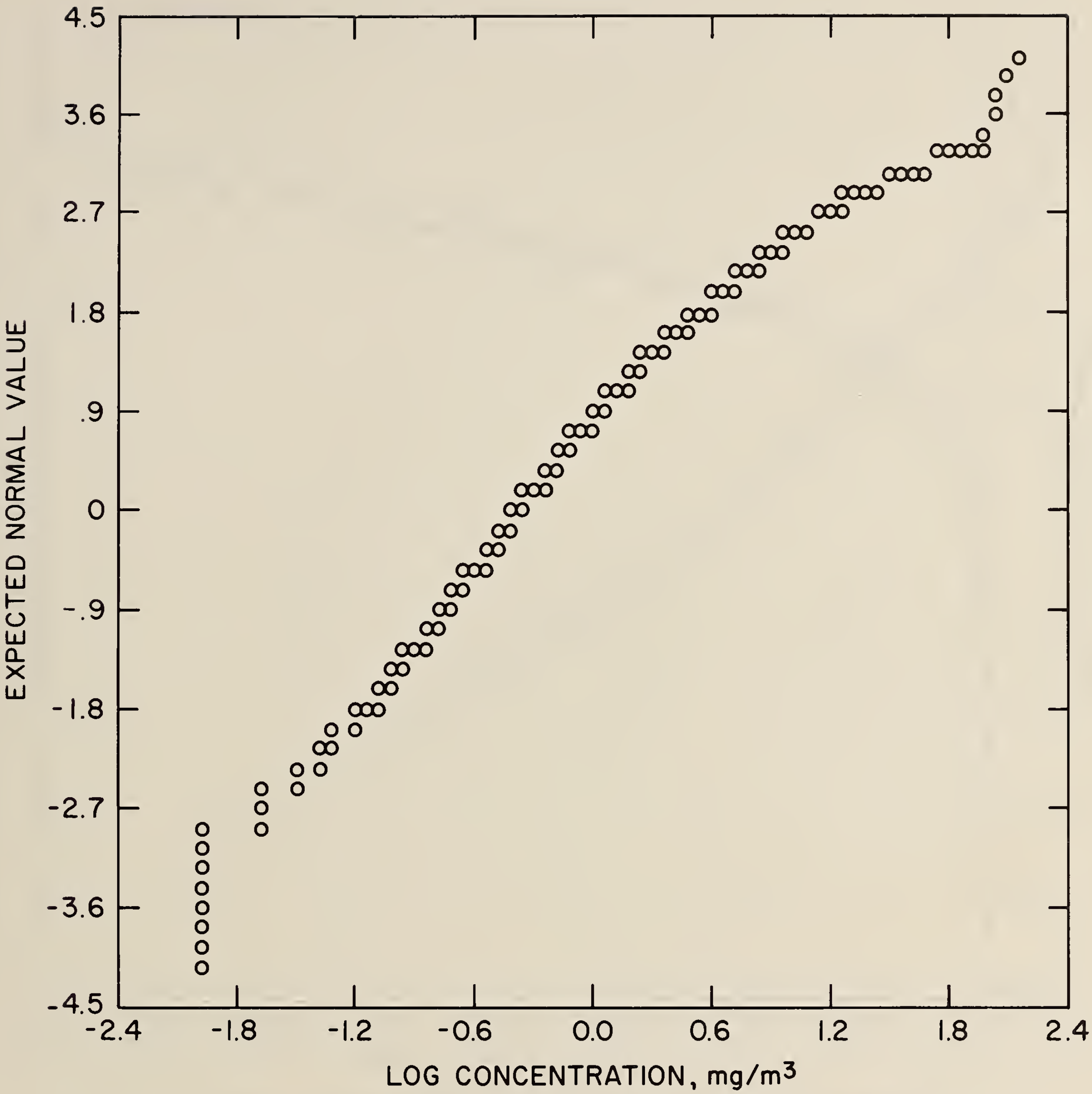

FIGURE A-2. - Log normal probability plot of respirable quartz dust data, 1974-80.

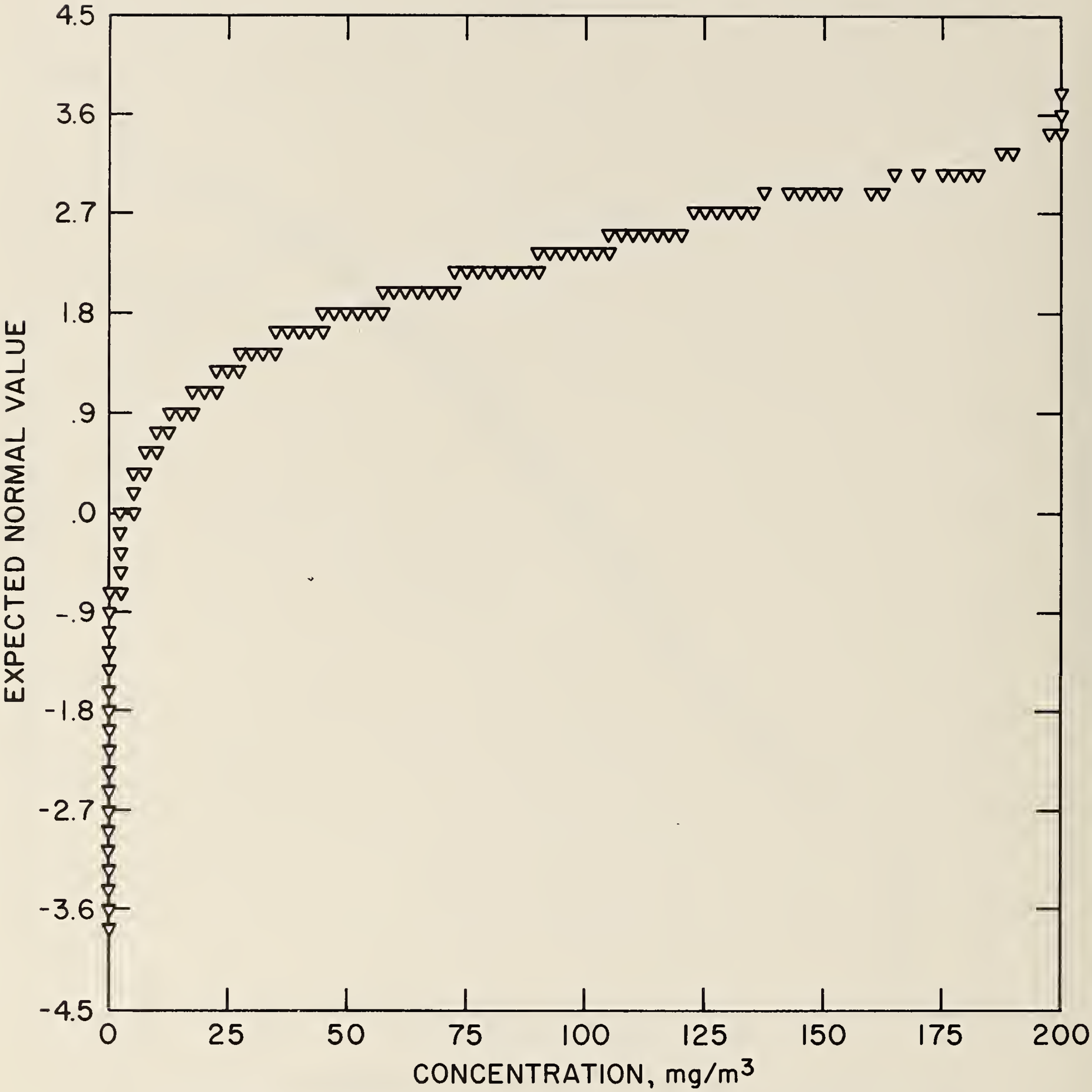

FIGURE A-3. - Probability plot of total nuisance dust data, 1974-80.

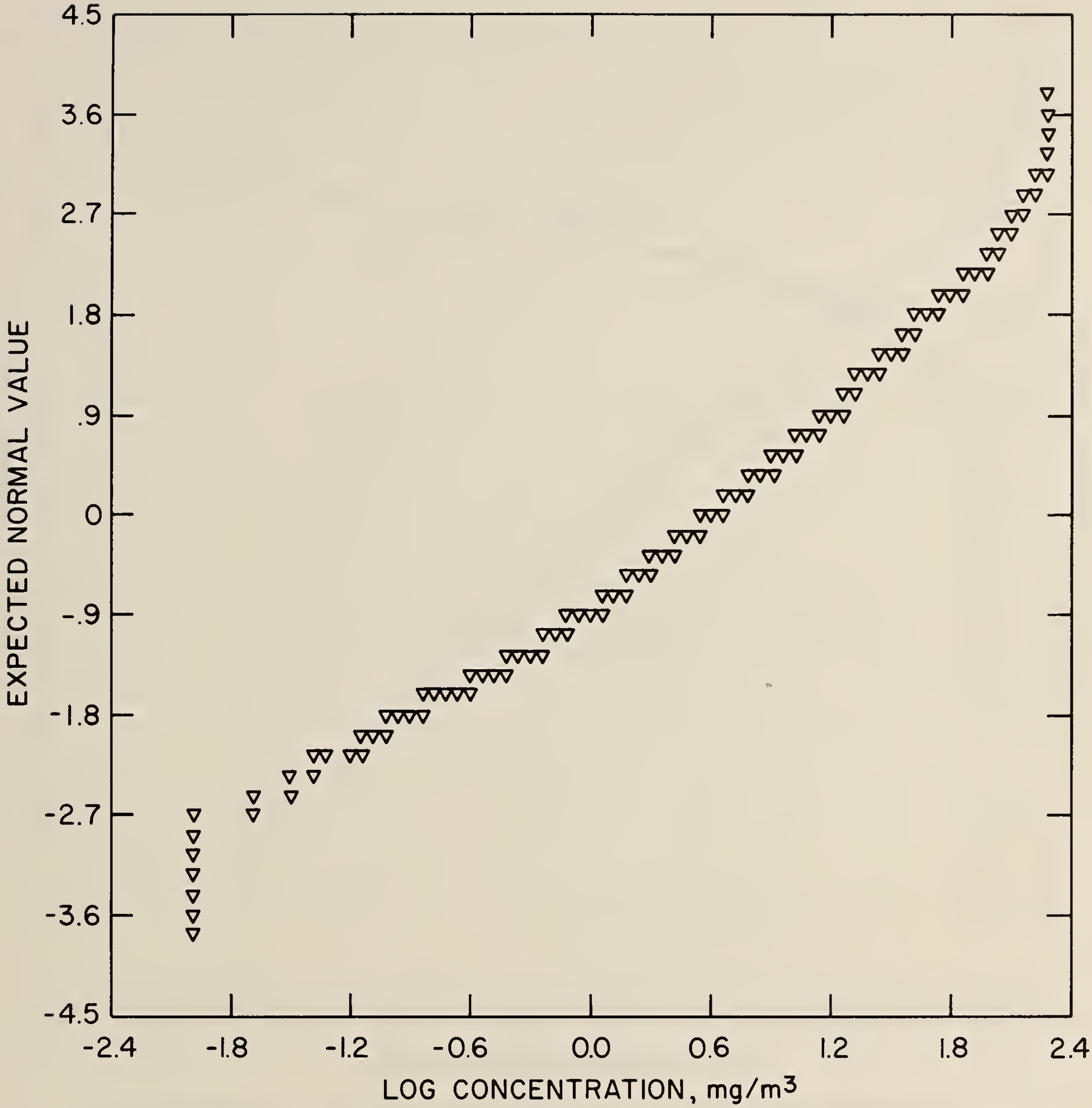

FIGURE A-4. - Log normal probability plot of total nuisance dust data, 1974-80.

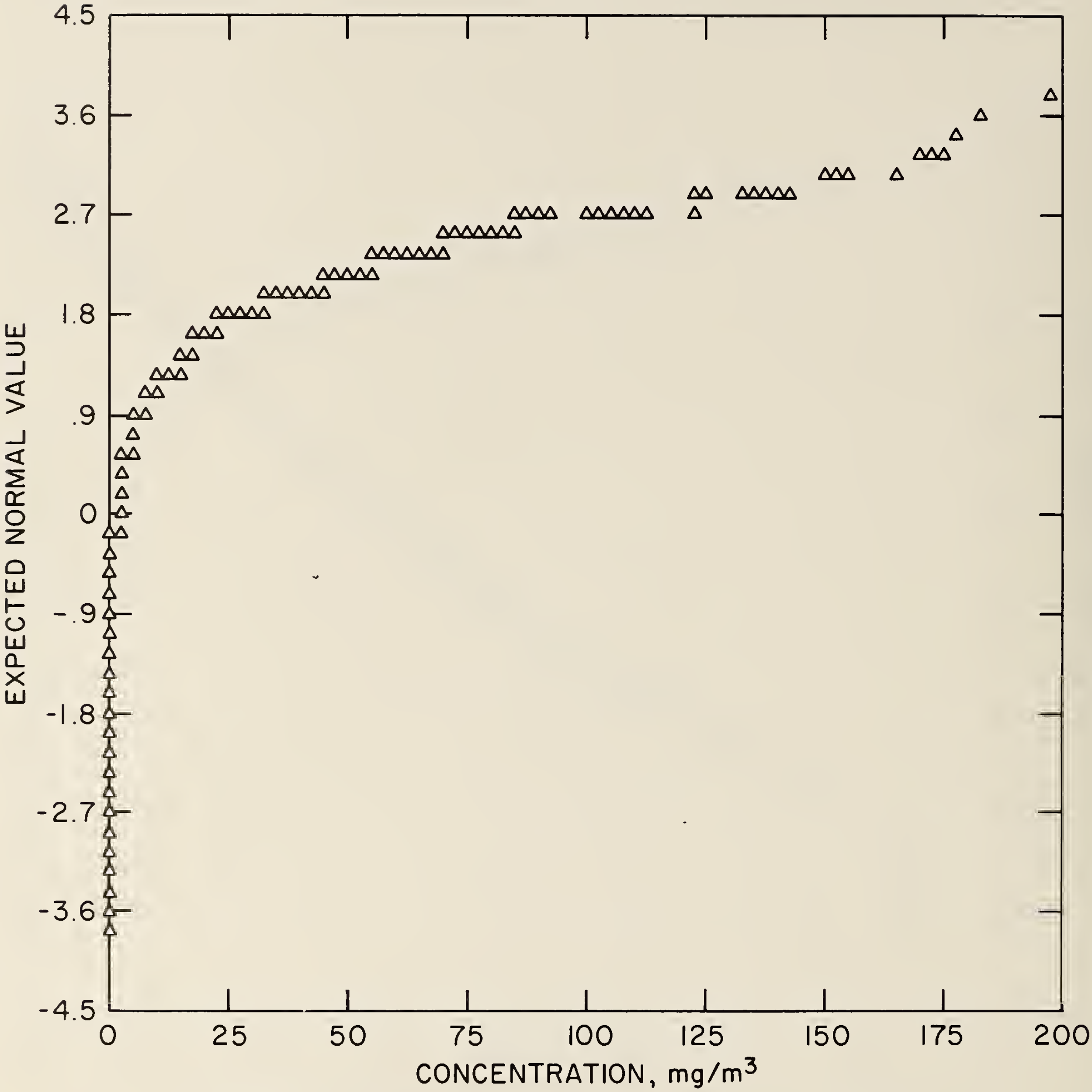

FIGURE A-5. - Probability plot of total silica dust data, 1974-80.

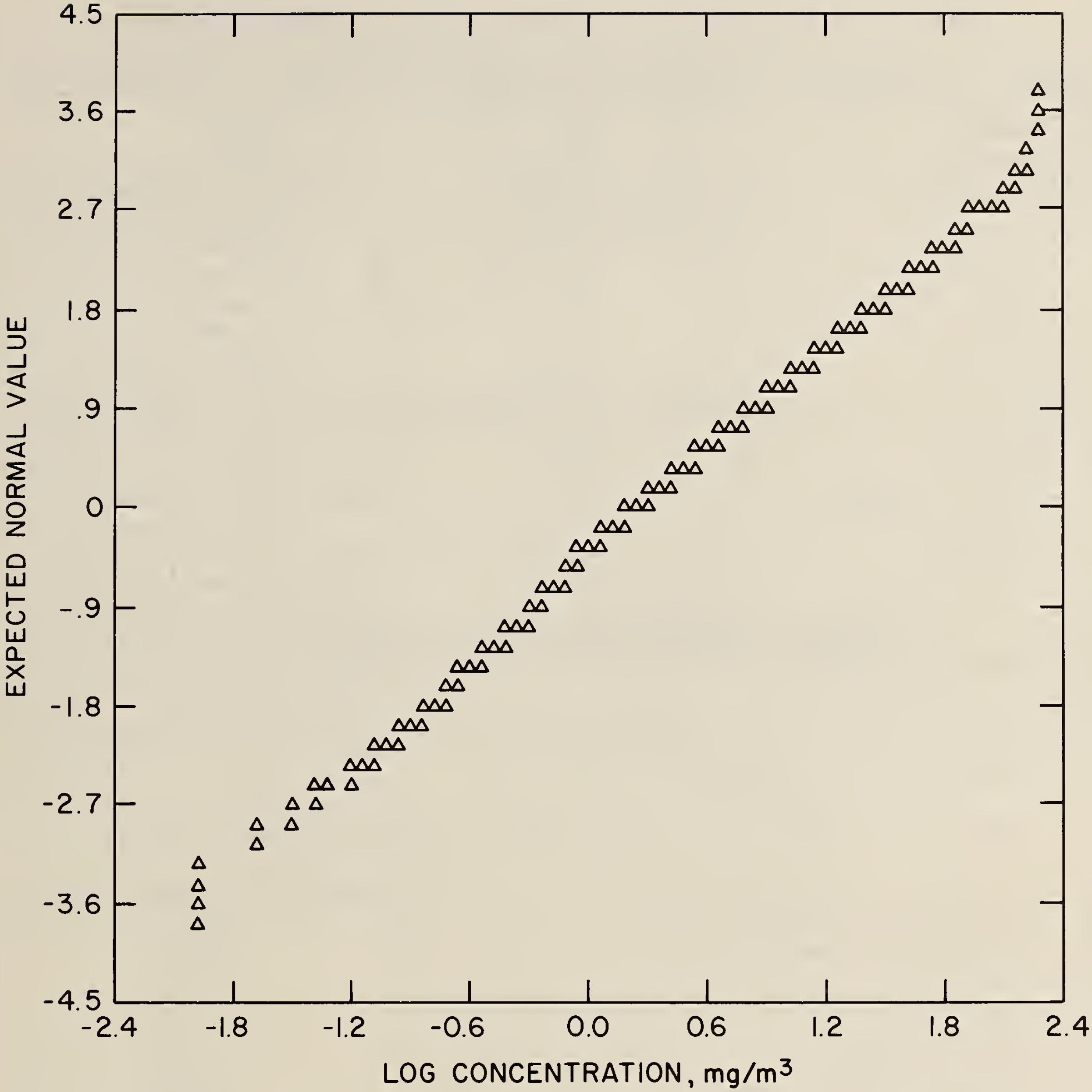

FIGURE A-6. - Log normal probability plot of total silica dust data, 1974-80.

TABLE A-1. - MSHA industry codes for metal and nonmetal mines

Code	Industry	Code	Industry	Code	Industry
			STONE QUARRIES AND MILLS		
01	Cement	04	Lime	07	Slate
02	Granite	05	Marble	08	Traprock
03	Limestone	06	Sandstone	09	Miscellaneous stone
			METAL MINES AND MILLS		
10	Antimony	14	Copper	19	Molybdenum
11	Bauxite (including alumina mills)	15	Gold-silver, lode and placer	20	Titanium
				21	Tungsten
12	Beryl	16	Iron	22	Uranium
13	Chromite	17	Lead-zinc	23	Mercury
		18	Manganese	29	Other metals
			NONMETAL MINES AND MILLS		
40	Asbestos	46	Gypsum	53	Sodium compounds
41	Barite	47	Magnesite	54	Sulfur
42	Boron minerals	48	Mica	55	Talc, soapstone, and pyrophyllite
43	Clay and shale	49	Phosphate rock		
44	Feldspar	50	Potash	56	Gilsonite
45	Fluorspar	51	Pumice	58	Oil and/or shale
		52	Salt	59	Other nonmetals
			MISCELLANEOUS NONFUEL MINES AND MILLS		
60	Sand and gravel				

NOTE.--Other metals and other nonmetals are defined in the Standard Industrial Classification (SIC) Codes published by the National Bureau of Standards, 1979, Washington, D.C.

TABLE A-2. - MSHA mine location codes for metal and nonmetal mines

Code	Mine location	Number of personal samples
01	Underground metal mine	9,741
02	Underground nonmetal mine	6,617
03	Underground stone mine	2,060
04	Underground shop	327
05	Underground mill	285
10	Open pit metal	4,254
11	Open pit nonmetal mine	9,802
12	Open pit crushed stone	36,015
13	Sand and gravel	19,453
20	Surface, shop	7,000
21	Surface, crushing	12,318
22	Surface, grinding	5,070
23	Surface, flotation and reagents	2,138
24	Surface, miscellaneous	11,340
25	Surface, mill (bagging, screening, etc.)	19,399

TABLE A-3. - MSHA operation codes for metal and nonmetal mines

Code	Operation	Number of personal samples	Code	Operation	Number of personal samples
01	Slushing................	589	20	Hoisting............	638
02	Machine mucking.........	409	21	Bulldozing..........	3,774
03	Hand mucking............	209	22	Slurry..............	238
04	Timbering...............	386	23	General labor and cleanup............	13,299
05	Rock bolting............	331			
06	Backfilling.............	28	24	General shopwork....	1,766
07	Blasting................	484	25	Welding.............	8,342
08	Rock sawing.............	712	26	Mechanic............	4,989
09	Drilling, percussive....	5,540	27	Crushing............	17,698
10	Drilling, rotary........	2,998	28	Grinding............	4,640
11	Drilling, diamond.......	293	29	Roasting, retorting.	1,443
12	Loading, hauling, dumping--electric.	3,249	30	Drying, filtering, and thickening.	3,624
13	Loading, hauling, dumping--diesel.	44,719	31	Sizing..............	5,080
			32	Concentrating.......	1,412
14	Loading, hauling, dumping--gasoline.	1,630	33	Chemical operations.	485
			34	Supply handling.....	1,411
15	Loading, hauling, dumping--compressed air.	673	35	Technical services..	875
			36	Administration......	1,479
16	Mining machine operator.	576	37	Bagger..............	6,026
17	Track crew..............	150	38	Pelletizing.........	652
18	Complete mining cycle...	3,025	39	Dredging............	1,313
19	Concrete operations.....	548	40	Jet piercing........	188

TABLE A-4. - MSHA contaminant codes for personal samples and the number of records for each contaminant

Code	Type of measurement	Unit of measurement	Number of records
1	Respirable quartz dust...........	mg/m^3	42,865
2	Midget impinger, quartz dust.....	mppcf	30
3	Talc, nonasbestiform.............	mppcf	195
4	Nuisance dust, total particulate.	mg/m^3	9,814
5	Mica.............................	mppcf	11
6	Perlite..........................	mppcf	11
7	Soapstone........................	mppcf	1
8	Diatomaceous earth...............	mppcf	31
9	Tremolite........................	mppcf	14
10	Graphite.........................	mppcf	25
11	Cristobalite, respirable.........	mg/m^3	134
12	Tridymite, respirable............	mg/m^3	7
13	Mercury vapor....................	mg/m^3	67
14	Lead, total particulate..........	mg/m^3	828
15	Cadmium, total particulate.......	mg/m^3	276
16	Arsenic and compounds, total particulate.	$\mu g/m^3$	710
17	Manganese, total particulate.....	$\mu g/m^3$	865
18	Beryllium, total particulate.....	$\mu g/m^3$	224
19	Iron oxide, total particulate....	mg/m^3	836
20	Asbestos, fibers greater than 5μm	$fibers/cm^3$	842
21	Cobalt, total particulate........	mg/m^3	399
22	Copper fume, total particulate...	mg/m^3	488
23	Molybdenum, total particulate....	mg/m^3	282
24	Nickel, total particulate........	mg/m^3	428
25	Platinum, total particulate......	$\mu g/m^3$	7
26	Tungsten, total particulate......	mg/m^3	7
27	Vanadium fume, total particulate.	$\mu g/m^3$	505
28	Zinc oxide fume, total particulate.	mg/m^3	478
29	Chromium, total particulate......	mg/m^3	452
31	Oil mist, total particulate......	mg/m^3	50
32	Diesel fumes.....................	mg/m^3	3
33	Cyanides, total particulate......	mg/m^3	2
34	Total airborne silica dust.......	mg/m^3	7,153
35	Welding fume, total particulate..	mg/m^3	573
36	Mercury compounds................	mg/m^3	0
40	Noise, dosimeter measurement.....	pct	73,247
41	Sound level meter measurement....	dBA	1,611
81	Magnesium oxides, total particulate.	mg/m^3	400
82	Aluminum oxides, total particulate.	mg/m^3	498
83	Titanium oxides, total particulate.	mg/m^3	500

NOTE.--After the data were edited, code 02 was reassigned to respirable nuisance dust and the midget impinger records were saved on a backup tape.

TABLE A-5. - MSHA contaminant codes for area samples and the number of records for each contaminant

Code	Type of measurment	Unit of measurement	Number of records
13	Mercury vapor....................	mg/m^3	688
50	Radon daughter measurement......	WL	15,736
70	Nitrogen oxide, NO..............	ppm	107
71	Nitrogen dioxide, NO_2...........	ppm	6,160
72	Nitrogen oxides, NOx............	ppm	262
73	Carbon monoxide, CO.............	ppm	17,223
74	Carbon dioxide, CO_2.............	ppm	14,582
75	Aldehydes.......................	ppm	109
67	Ammonia, NH_3....................	ppm	144
77	Hydrogen sulfide, H_2S...........	ppm	1,615
78	Sulfur dioxide, SO_2.............	ppm	354
79	Chlorine, Cl_2...................	ppm	15
80	Sulfuric acid mist..............	mg/m^3	1
87	Hydrogen cyanide, HCN...........	ppm	111
88	Carbon disulfide, CS_2...........	ppm	3
89	Perchlorethylene................	ppm	9
90	Phosgene........................	ppm	14
91	Oxygen..........................	pct	9,435
92	Hydrocarbons, total.............	ppm	88
93	Methane.........................	pct	13,431

NOTE.--WL is working level.

TABLE A-6. -Industry by location breakdown for respirable quartz dust, 1975

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	89	23.60	10.5	118	38.14	11.4	4	25.00	16.5	100	32.00	14.8	67	29.85	16.5	378	31.48	13.0
1CEMENT	49	22.45	6.8	0	0.00	0.0	0	0.00	0.0	34	47.06	6.0	18	16.67	3.0	101	29.70	5.9
2GRANITE	63	36.51	16.0	0	0.00	0.0	0	0.00	0.0	9	11.11	10.8	44	50.00	20.6	116	39.66	17.3
3LIMESTONE	268	11.57	5.2	32	12.50	3.9	0	0.00	0.0	110	27.27	5.4	123	22.76	4.3	533	17.45	5.0
4LIME	13	15.38	5.5	0	0.00	0.0	0	0.00	0.0	9	22.22	5.2	14	35.71	5.9	36	25.00	5.6
5MARBLE	0	0.00	0.0	5	100.00	2.9	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	5	100.00	2.9
6SANDSTONE	54	24.07	19.9	1	100.00	25.0	3	0.00	5.4	55	38.18	30.9	113	52.21	26.3	226	41.59	25.6
7SLATE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	13.4	2	0.00	13.4
8TRAPROCK	25	4.00	5.6	0	0.00	0.0	0	0.00	0.0	5	20.00	11.3	1	0.00	4.4	31	6.45	6.5
9MIS.STONE	24	12.50	5.9	0	0.00	0.0	1	0.00	8.5	15	33.33	21.2	23	65.22	40.4	63	36.51	22.2
10ANTIMONY	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	93	3.23	10.5	116	24.14	11.4	14	7.14	13.3	95	32.63	13.5	13	23.08	15.3	331	19.94	12.0
15GOLD-SILV	0	0.00	0.0	55	43.64	14.6	0	0.00	0.0	0	0.00	0.0	1	100.00	15.0	56	44.64	14.6
16IRON	24	4.17	7.2	0	0.00	0.0	1	0.00	6.0	35	20.00	15.5	42	14.29	7.8	102	13.73	10.3
17LEAD-ZINC	0	0.00	0.0	138	26.09	10.7	2	0.00	2.4	16	6.25	4.1	13	0.00	3.8	169	21.89	9.4
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	2.4	4	0.00	2.5	5	0.00	2.5
19MOLY.	0	0.00	0.0	7	71.43	11.4	0	0.00	0.0	17	52.94	24.2	1	0.00	5.6	25	56.00	19.9
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	5.5	5	0.00	3.4	7	0.00	4.0
21TUNGSTEN	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
22URANIUM	0	0.00	0.0	67	35.82	12.6	0	0.00	0.0	13	30.77	12.8	14	7.14	6.2	94	30.85	11.7
23MERCURY	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
29OTHER MET	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
41BARITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	33.33	8.7	4	50.00	11.0	7	42.86	10.0
42BORON	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
43CLAY&SHLE	29	51.72	14.7	3	33.33	2.6	1	0.00	6.5	55	52.73	13.1	34	23.53	9.7	122	43.44	12.2
44FELDSPAR	1	0.00	5.9	0	0.00	0.0	0	0.00	0.0	6	83.33	19.7	10	30.00	11.5	17	47.06	14.1
45FLOURSPAR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	4.3	0	0.00	0.0	3	0.00	4.3
46GYPSUM	12	0.00	5.3	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	12	0.00	5.3
47MAGNESITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
48MICA	0	0.00	0.0	0	0.00	0.0	2	100.00	46.6	0	0.00	0.0	0	0.00	0.0	2	100.00	46.6
49PHOSPHATE	26	34.62	15.5	19	21.05	10.9	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	45	28.89	13.6
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
51PUMICE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
52SALT	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
53SODIUM	0	0.00	0.0	10	20.00	2.4	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	10	20.00	2.4
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	1	0.00	3.6	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	1.6	2	0.00	2.6
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
59NONMETALS	2	0.00	1.2	0	0.00	0.0	1	0.00	3.7	3	66.67	18.9	15	73.33	14.3	21	61.90	13.2
60SAND&GRAV	70	22.86	16.0	0	0.00	0.0	1	0.00	2.1	22	31.82	23.3	96	46.88	26.7	189	35.98	22.2
COL.TOTALS	843	17.67	9.8	571	31.35	11.0	30	13.33	13.1	608	33.55	13.9	658	35.26	16.1	2710	28.34	12.5

TABLE A-7. -Industry by location breakdown for respirable quartz dust, 1976

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	227	16.74	8.9	72	20.83	8.3	4	0.00	7.4	155	39.35	10.7	173	31.79	13.9	631	26.78	10.6
1CEMENT	305	17.70	5.9	5	0.00	2.1	7	0.00	2.8	85	32.94	3.8	316	20.57	3.8	718	20.47	4.7
2GRANITE	307	26.71	15.6	0	0.00	0.0	1	0.00	28.3	34	26.47	10.4	43	18.60	11.8	385	25.71	14.8
3LIMESTONE	774	11.37	5.2	49	26.53	3.2	17	5.88	2.3	243	27.57	5.1	247	24.70	5.0	1330	17.29	5.0
4LIME	30	20.00	3.1	0	0.00	0.0	1	0.00	1.5	15	13.33	2.4	41	21.95	3.7	87	19.54	3.3
5MARBLE	0	0.00	0.0	4	75.00	1.3	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	4	75.00	1.3
6SANDSTONE	138	38.41	21.5	9	22.22	16.1	5	0.00	10.4	52	32.69	18.4	155	50.32	25.9	359	41.78	22.6
7SLATE	5	0.00	7.0	5	40.00	12.9	7	14.29	19.3	7	57.14	18.8	16	37.50	15.3	40	32.50	15.3
8TRAPROCK	43	13.95	6.3	0	0.00	0.0	1	0.00	2.6	14	35.71	4.8	33	15.15	3.9	91	17.58	5.1
9MIS.STONE	4	0.00	7.9	0	0.00	0.0	1	100.00	41.5	3	66.67	41.2	14	85.71	50.3	22	68.18	40.9
10ANTIMONY	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	3.9	1	0.00	2.8	3	0.00	3.5
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	112	20.54	10.4	44	11.36	4.9	8	62.50	10.8	113	46.02	10.9	38	39.47	16.4	315	31.75	10.6
15GOLD-SILV	11	36.36	12.2	34	11.76	8.9	0	0.00	0.0	7	57.14	9.0	9	22.22	10.5	61	22.95	9.7
16IRON	23	8.70	12.4	4	0.00	2.6	0	0.00	0.0	149	39.60	14.0	88	26.14	9.5	264	31.82	12.2
17LEAD-ZINC	0	0.00	0.0	203	14.78	8.7	1	0.00	2.8	17	23.53	10.1	13	0.00	3.9	234	14.53	8.5
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
19MOLY.	6	16.67	11.8	132	48.48	11.0	0	0.00	0.0	20	50.00	17.8	3	33.33	17.3	161	47.20	12.0
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	33.33	2.6	3	33.33	2.6
21TUNGSTEN	0	0.00	0.0	2	0.00	6.7	1	100.00	3.4	1	100.00	12.1	0	0.00	0.0	4	50.00	7.2
22URANIUM	12	8.33	11.3	58	15.52	6.3	2	0.00	4.6	9	0.00	6.7	14	7.14	8.8	95	11.58	7.3
23MERCURY	1	0.00	5.3	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	5.3
29OTHER MET	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	6.8	3	0.00	6.8
41BARITE	5	20.00	10.4	0	0.00	0.0	1	0.00	1.4	6	50.00	18.9	16	62.50	6.0	28	50.00	9.4
42BORON	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
43CLAY&SHLE	99	28.28	11.3	42	64.29	7.9	8	12.50	12.4	162	45.68	11.3	142	56.34	9.7	453	46.36	10.5
44FELDSPAR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	100.00	13.2	3	0.00	6.9	4	25.00	8.4
45FLOURSPAR	0	0.00	0.0	25	44.00	4.3	0	0.00	0.0	3	0.00	4.3	3	0.00	6.6	31	35.48	4.5
46GYPSUM	1	0.00	3.0	7	0.00	1.3	0	0.00	0.0	1	0.00	1.1	5	0.00	2.9	14	0.00	2.0
47MAGNESITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
48MICA	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	50.00	19.6	2	50.00	19.6
49PHOSPHATE	115	13.91	9.0	0	0.00	0.0	0	0.00	0.0	4	75.00	8.5	4	50.00	2.4	123	17.07	8.8
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
51PUMICE	11	0.00	11.0	0	0.00	0.0	0	0.00	0.0	1	0.00	24.3	0	0.00	0.0	12	0.00	12.1
52SALT	0	0.00	0.0	1	0.00	1.1	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	1.1
53SODIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	4	0.00	15.7	0	0.00	0.0	0	0.00	0.0	2	100.00	9.5	10	50.00	8.5	16	43.75	10.4
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
59NONMETALS	7	0.00	6.5	6	16.67	8.5	0	0.00	0.0	7	71.43	33.7	48	47.92	20.5	68	42.65	19.4
60SAND&GRAV	557	18.49	12.5	0	0.00	0.0	6	0.00	12.7	47	31.91	13.3	141	23.40	17.0	751	20.11	13.4
COL.TOTALS	2797	18.09	9.7	702	26.50	8.0	71	14.08	8.8	1160	36.90	10.1	1584	31.31	11.0	6314	25.75	9.9

TABLE A-8. -Industry by location breakdown for respirable quartz dust, 1977

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	238	17.23	14.2	75	24.00	5.4	4	0.00	6.9	176	39.20	8.5	215	23.72	8.5	708	25.28	10.1
1CEMENT	208	12.02	4.5	2	50.00	1.5	26	3.85	4.0	85	15.29	3.3	238	11.76	3.0	559	12.16	3.6
2GRANITE	524	19.66	12.9	0	0.00	0.0	2	0.00	12.7	46	8.70	10.3	71	16.90	8.6	643	18.51	12.2
3LIMESTONE	804	7.84	5.0	64	23.44	2.9	8	0.00	1.9	208	15.87	4.4	159	8.18	4.3	1243	9.98	4.7
4LIME	13	0.00	3.7	0	0.00	0.0	2	50.00	1.2	18	11.11	5.4	22	18.18	2.6	55	12.73	3.7
5MARBLE	0	0.00	0.0	1	0.00	1.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	1.0
6SANDSTONE	245	17.55	14.2	10	70.00	14.1	5	0.00	13.9	98	37.76	23.0	271	39.85	25.1	629	31.00	20.3
7SLATE	52	3.85	11.0	2	0.00	7.2	0	0.00	0.0	3	0.00	4.0	58	24.14	7.8	115	13.91	9.1
8TRAPROCK	97	7.22	8.9	0	0.00	0.0	1	0.00	6.6	35	11.43	4.2	19	10.53	3.8	152	8.55	7.2
9MIS.STONE	18	5.56	8.2	0	0.00	0.0	1	0.00	31.3	6	66.67	22.9	13	53.85	24.3	38	31.58	16.6
10ANTIMONY	0	0.00	0.0	5	20.00	9.2	0	0.00	0.0	1	100.00	20.2	1	0.00	2.0	7	28.57	9.7
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	8.2	1	0.00	8.2
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	45	11.11	6.1	304	19.74	5.6	8	0.00	7.1	111	11.71	6.7	138	11.59	6.3	606	15.51	6.0
15GOLD-SILV	22	22.73	13.1	46	2.17	7.8	1	0.00	4.8	11	54.55	16.0	4	75.00	10.0	84	17.86	10.3
16IRON	57	1.75	11.4	11	0.00	3.9	2	0.00	4.5	83	28.92	12.9	96	9.38	5.6	249	13.65	9.3
17LEAD-ZINC	0	0.00	0.0	114	29.82	6.6	0	0.00	0.0	19	5.26	10.2	9	11.11	6.0	142	25.35	7.0
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	1.7	2	0.00	1.7
19MOLY.	0	0.00	0.0	162	20.99	5.6	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	162	20.99	5.6
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
21TUNGSTEN	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
22URANIUM	10	40.00	7.8	207	15.94	6.6	2	0.00	10.4	15	13.33	5.1	22	13.64	7.6	256	16.41	6.7
23MERCURY	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
29OTHER MET	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
41BARITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	1.6	2	50.00	4.0	3	33.33	3.2
42BORON	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
43CLAY&SHLE	256	10.55	5.2	72	43.06	6.4	7	0.00	3.3	125	42.40	8.9	279	37.28	8.0	739	29.09	7.0
44FELDSPAR	9	44.44	38.1	0	0.00	0.0	0	0.00	0.0	25	44.00	13.2	3	33.33	9.0	37	43.24	18.9
45FLOURSPAR	0	0.00	0.0	12	8.33	2.1	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	12	8.33	2.1
46GYPSUM	4	25.00	20.4	4	0.00	2.6	0	0.00	0.0	3	0.00	1.4	3	0.00	2.9	14	7.14	7.5
47MAGNESITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
48MICA	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	10	0.00	3.7	10	0.00	3.7
49PHOSPHATE	102	24.51	10.8	33	18.18	9.4	2	0.00	8.0	6	50.00	19.2	5	0.00	2.4	148	22.97	10.5
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
51PUMICE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
52SALT	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
53SODIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	11	36.36	12.6	11	0.00	2.6	0	0.00	0.0	2	0.00	4.1	7	71.43	46.9	31	29.03	16.3
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	2	50.00	2.8	0	0.00	0.0	2	100.00	4.4	0	0.00	0.0	4	75.00	3.6
59NONMETALS	10	30.00	21.3	8	12.50	7.7	1	0.00	9.4	7	57.14	20.0	73	41.10	17.5	99	38.38	17.2
60SAND&GRAV	729	14.68	14.0	0	0.00	0.0	2	0.00	16.0	36	13.89	11.8	229	38.43	17.6	996	20.08	14.8
COL.TOTALS	3454	13.64	10.1	1145	21.31	6.0	74	2.70	6.1	1122	25.94	9.1	1950	25.64	10.9	7745	19.47	9.5

TABLE A-9. -Industry by location breakdown for respirable quartz dust, 1978

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	155	18.71	11.1	30	33.33	5.7	0	0.00	0.0	87	18.39	6.4	94	21.28	8.3	366	20.49	8.8
1CEMENT	197	5.58	5.8	10	0.00	2.8	9	0.00	2.0	109	21.10	4.2	197	14.72	3.9	522	12.07	4.7
2GRANITE	402	26.62	12.4	0	0.00	0.0	4	0.00	5.8	50	16.00	12.6	21	23.81	11.1	477	25.16	12.3
3LIMESTONE	1491	5.57	5.5	177	20.90	3.1	7	14.29	6.4	297	11.78	3.6	206	11.17	4.9	2178	8.22	5.0
4LIME	48	4.17	4.2	5	40.00	8.0	1	0.00	2.5	6	16.67	8.9	35	11.43	4.0	95	9.47	4.6
5MARBLE	3	0.00	2.3	2	0.00	1.0	0	0.00	0.0	14	0.00	1.6	2	50.00	1.6	21	4.76	1.7
6SANDSTONE	239	29.29	21.9	11	9.09	20.8	1	0.00	9.6	67	41.79	26.3	103	35.92	26.6	421	32.30	23.7
7SLATE	2	0.00	11.3	0	0.00	0.0	4	0.00	8.1	9	22.22	11.3	13	7.69	8.2	28	10.71	9.4
8TRAPROCK	84	13.10	8.9	0	0.00	0.0	0	0.00	0.0	27	33.33	9.8	21	9.52	5.2	132	16.67	8.5
9MIS.STONE	32	3.13	10.1	0	0.00	0.0	0	0.00	0.0	15	13.33	13.8	15	46.67	30.3	62	16.13	15.9
10ANTIMONY	0	0.00	0.0	3	0.00	9.1	0	0.00	0.0	2	50.00	20.3	0	0.00	0.0	5	20.00	13.6
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	39	17.95	10.4	48	16.67	5.7	9	0.00	12.9	86	34.88	9.8	49	28.57	8.4	231	25.54	8.9
15GOLD-SILV	10	20.00	16.9	195	17.44	12.3	5	40.00	10.2	30	43.33	13.0	14	35.71	7.9	254	22.05	12.3
16IRON	179	5.59	12.0	41	24.39	4.7	2	0.00	3.1	157	22.93	13.6	122	3.28	6.6	501	11.98	10.6
17LEAD-ZINC	0	0.00	0.0	100	16.00	6.7	1	0.00	1.3	20	15.00	9.4	15	33.33	20.8	136	17.65	8.6
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	2.2	2	0.00	2.2
19MOLY.	3	0.00	4.1	87	22.99	8.2	0	0.00	0.0	6	16.67	13.1	1	0.00	1.7	97	21.65	8.3
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	3.0	3	0.00	3.0
21TUNGSTEN	0	0.00	0.0	9	11.11	4.9	1	0.00	4.3	1	0.00	13.4	2	0.00	7.0	13	7.69	5.8
22URANIUM	51	9.80	6.7	257	5.84	7.2	0	0.00	0.0	16	12.50	6.8	49	14.29	7.5	373	7.77	7.1
23MERCURY	5	40.00	16.3	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	5	40.00	16.3
29OTHER MET	2	0.00	6.8	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	6.8
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
41BARITE	1	100.00	15.2	0	0.00	0.0	0	0.00	0.0	3	66.67	4.9	8	37.50	5.3	12	50.00	6.0
42BORON	1	0.00	7.6	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	7.6
43CLAY&SHLE	154	16.88	11.9	32	12.50	5.4	2	0.00	4.1	120	29.17	8.4	274	47.08	10.3	582	33.33	10.0
44FELDSPAR	8	12.50	12.7	0	0.00	0.0	0	0.00	0.0	8	0.00	4.6	13	23.08	14.7	29	13.79	11.4
45FLOURSPAR	0	0.00	0.0	46	17.39	3.2	0	0.00	0.0	10	10.00	13.5	5	20.00	5.3	61	16.39	5.1
46GYPSUM	34	5.88	4.9	9	0.00	1.5	0	0.00	0.0	7	0.00	3.4	6	0.00	12.7	56	3.57	5.0
47MAGNESITE	1	0.00	7.1	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	9.6	4	0.00	9.0
48MICA	3	0.00	3.9	0	0.00	0.0	0	0.00	0.0	2	0.00	7.5	6	0.00	3.2	11	0.00	4.2
49PHOSPHATE	16	0.00	10.9	26	15.38	10.3	0	0.00	0.0	11	0.00	6.7	10	20.00	9.2	63	9.52	9.7
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	2.4	0	0.00	0.0	2	0.00	2.4
51PUMICE	7	14.29	2.9	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	7	14.29	2.9
52SALT	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
53SODIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	2	0.00	3.8	1	100.00	1.2	0	0.00	0.0	3	0.00	7.8	4	0.00	1.4	10	10.00	3.7
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
59NONMETALS	39	10.26	9.3	32	12.50	7.6	0	0.00	0.0	15	73.33	40.4	89	71.91	37.3	175	47.43	25.9
60SAND&GRAV	1152	10.16	12.9	0	0.00	0.0	0	0.00	0.0	83	25.30	15.3	113	35.40	21.9	1348	13.20	13.8
COL.TOTALS	4360	11.28	9.9	1121	15.61	7.2	46	6.52	6.9	1263	22.17	9.6	1495	27.16	11.7	8285	16.37	9.8

TABLE A-10. -Industry by location breakdown for respirable quartz dust, 1979

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	47	10.64	12.0	9	0.00	6.0	0	0.00	0.0	11	0.00	10.1	27	18.52	5.7	94	10.64	9.4
1CEMENT	138	4.35	5.5	0	0.00	0.0	2	0.00	4.4	59	11.86	3.6	140	16.43	5.0	339	10.62	5.0
2GRANITE	743	18.84	9.8	0	0.00	0.0	0	0.00	0.0	66	15.15	9.6	64	18.75	9.4	873	18.56	9.7
3LIMESTONE	1419	5.57	5.0	135	8.89	2.9	3	0.00	2.9	246	7.72	4.3	147	8.16	3.7	1950	6.26	4.7
4LIME	32	18.75	4.3	0	0.00	0.0	1	0.00	2.0	16	31.25	6.7	42	19.05	3.3	91	20.88	4.2
5MARBLE	2	50.00	5.9	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	4	0.00	3.3	6	16.67	4.1
6SANDSTONE	331	16.62	16.6	27	25.93	13.4	3	33.33	8.9	78	39.74	18.2	172	38.37	23.2	611	26.19	18.5
7SLATE	57	0.00	11.7	0	0.00	0.0	0	0.00	0.0	3	0.00	8.5	11	18.18	11.8	71	2.82	11.6
8TRAPROCK	59	10.17	10.3	0	0.00	0.0	0	0.00	0.0	38	23.68	6.9	2	0.00	19.7	99	15.15	9.2
9MIS.STONE	56	12.50	8.2	0	0.00	0.0	0	0.00	0.0	14	21.43	6.6	14	14.29	13.7	84	14.29	8.8
10ANTIMONY	0	0.00	0.0	2	0.00	7.0	0	0.00	0.0	1	100.00	23.0	0	0.00	0.0	3	33.33	12.3
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	2.5	1	100.00	14.7	3	33.33	6.5
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	17.2	1	0.00	53.6	2	0.00	35.4
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	102	20.59	10.7	44	22.73	7.4	6	0.00	3.2	85	37.65	9.2	25	28.00	8.5	262	26.72	9.3
15GOLD-SILV	5	0.00	8.3	163	5.52	8.8	4	0.00	2.9	42	30.95	14.7	8	25.00	11.2	222	10.81	9.8
16IRON	221	10.86	11.4	30	3.33	3.7	2	0.00	1.4	157	15.92	10.9	64	12.50	5.5	474	12.24	9.9
17LEAD-ZINC	0	0.00	0.0	44	9.09	11.1	2	0.00	8.0	14	0.00	8.0	6	16.67	9.1	66	7.58	10.2
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	33.33	3.6	0	0.00	0.0	3	33.33	3.6
19MOLY.	1	0.00	6.1	21	33.33	7.2	0	0.00	0.0	12	75.00	15.6	2	0.00	7.5	36	44.44	10.0
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
21TUNGSTEN	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	2.6	1	0.00	2.6	2	0.00	2.6
22URANIUM	40	0.00	7.3	97	0.00	4.4	3	0.00	3.2	22	9.09	5.5	16	31.25	5.7	178	3.93	5.3
23MERCURY	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
29OTHER MET	1	0.00	14.7	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	14.7
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
41BARITE	7	0.00	4.0	0	0.00	0.0	0	0.00	0.0	3	0.00	1.0	9	22.22	2.1	19	10.53	2.6
42BORON	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	2.3	2	0.00	5.0	5	0.00	3.4
43CLAY&SHLE	108	8.33	8.4	24	20.83	5.6	2	0.00	3.2	19	36.84	8.0	223	31.84	7.5	376	24.47	7.7
44FELDSPAR	3	0.00	9.5	0	0.00	0.0	0	0.00	0.0	10	10.00	10.6	9	11.11	2.4	22	9.09	7.1
45FLOURSPAR	0	0.00	0.0	8	0.00	1.7	0	0.00	0.0	2	0.00	9.9	0	0.00	0.0	10	0.00	3.3
46GYPSUM	20	10.00	9.0	6	0.00	2.1	0	0.00	0.0	4	0.00	2.3	4	0.00	2.6	34	5.88	6.3
47MAGNESITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
48MICA	23	13.04	8.6	0	0.00	0.0	0	0.00	0.0	1	0.00	1.1	13	0.00	11.1	37	8.11	9.3
49PHOSPHATE	13	0.00	5.5	18	0.00	4.3	0	0.00	0.0	2	50.00	9.3	2	0.00	6.8	35	2.86	5.2
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
51PUMICE	2	0.00	4.1	0	0.00	0.0	0	0.00	0.0	1	0.00	3.7	0	0.00	0.0	3	0.00	4.0
52SALT	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
53SODIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	4	0.00	1.3	0	0.00	0.0	4	0.00	1.3
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	13	23.08	14.0	0	0.00	0.0	0	0.00	0.0	3	0.00	5.1	11	9.09	7.0	27	14.81	10.2
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
59NONMETALS	37	2.70	10.3	8	62.50	6.2	0	0.00	0.0	12	50.00	20.2	63	76.19	37.3	120	50.00	25.2
60SAND&GRAV	1344	10.34	10.2	1	0.00	8.3	5	0.00	7.2	84	13.10	12.2	183	31.69	16.4	1617	12.86	11.0
COL.TOTALS	4824	10.51	8.9	637	9.42	6.4	33	3.03	4.5	1019	18.94	8.9	1266	26.46	11.6	7779	14.09	9.1

TABLE A-11. - Industry by location breakdown for respirable quartz dust, 1974-80

	OPEN PIT AND SAND AND GRAVEL			UNDERGROUND			SURFACE SHOP			SURFACE CRUSHING, GRINDING, FLOTATION			SURFACE MILL AND MISCELLANEOUS			ROW SUMS		
	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA	NUMBER OBS.	PCT GETLV	PCT SILICA
0CLOSED	769	18.21	11.6	304	28.95	8.5	13	7.69	9.6	538	34.39	10.4	579	26.08	10.8	2203	25.65	10.6
1CEMENT	911	12.18	5.5	17	5.88	2.4	44	2.27	3.4	374	23.80	4.0	910	16.37	3.8	2256	15.56	4.5
2GRANITE	2042	22.28	12.2	0	0.00	0.0	7	0.00	11.0	206	16.02	10.7	249	24.90	12.0	2504	21.96	12.0
3LIMESTONE	4770	7.27	5.2	457	17.72	3.1	46	13.04	3.1	1119	16.98	4.4	897	15.61	4.6	7289	10.48	4.9
4LIME	136	11.76	4.0	5	40.00	8.0	5	20.00	1.7	64	18.75	5.3	154	19.48	3.7	364	16.76	4.1
5MARBLE	5	20.00	3.7	12	66.67	1.9	0	0.00	0.0	14	0.00	1.6	6	16.67	2.7	37	27.03	2.2
6SANDSTONE	1034	24.47	18.9	58	31.03	15.5	17	5.88	10.2	386	43.01	25.1	814	42.75	25.2	2309	34.04	22.0
7SLATE	116	1.72	11.2	7	28.57	11.3	11	9.09	15.2	22	27.27	12.3	100	23.00	9.6	256	13.28	10.8
8TRAPROCK	314	10.19	8.5	0	0.00	0.0	2	0.00	4.5	125	24.80	6.6	78	11.54	4.6	519	13.87	7.4
9MIS.STONE	136	9.56	8.3	0	0.00	0.0	3	33.33	27.1	55	29.09	16.5	82	52.44	32.0	276	26.45	17.2
10ANTIMONY	0	0.00	0.0	10	10.00	8.7	0	0.00	0.0	4	75.00	21.0	1	0.00	2.0	15	26.67	11.5
11BAUXITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	4	0.00	3.2	3	33.33	8.5	7	14.29	5.5
12BERYL	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	17.2	1	0.00	53.6	2	0.00	35.4
13CHROMITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
14COPPER	391	15.09	10.0	558	19.89	6.9	45	13.33	10.3	500	33.20	10.2	275	21.82	9.0	1769	22.72	8.9
15GOLD-SILV	48	22.92	13.2	493	14.60	10.7	10	20.00	6.7	90	40.00	13.8	36	36.11	9.7	677	19.79	11.2
16IRON	508	7.48	11.5	86	12.79	4.1	10	0.00	4.2	605	25.95	13.2	412	12.14	6.9	1621	15.79	10.6
17LEAD-ZINC	0	0.00	0.0	617	20.26	8.5	6	0.00	4.1	89	11.24	8.4	56	12.50	9.3	768	18.49	8.5
18MANGANESE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	4	25.00	3.3	8	0.00	2.2	12	8.33	2.6
19MOLY.	10	10.00	8.9	417	33.09	8.1	0	0.00	0.0	55	52.73	18.8	9	11.11	11.2	491	34.42	9.3
20TITANIUM	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	5.5	11	9.09	3.1	13	7.69	3.4
21TUNGSTEN	0	0.00	0.0	26	11.54	6.5	2	50.00	3.9	3	33.33	9.3	3	0.00	5.5	34	14.71	6.5
22URANIUM	113	8.85	7.5	686	11.81	7.1	7	0.00	5.7	75	13.33	7.1	115	14.78	7.3	996	11.85	7.1
23MERCURY	6	33.33	14.5	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	6	33.33	14.5
29OTHER MET	3	0.00	9.5	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	9.5
40ASBESTOS	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	6.8	3	0.00	6.8
41BARITE	13	15.38	7.3	0	0.00	0.0	1	0.00	1.4	16	37.50	9.9	39	46.15	5.4	69	37.68	6.7
42BORON	1	0.00	7.6	0	0.00	0.0	0	0.00	0.0	3	0.00	2.3	2	0.00	5.0	6	0.00	4.1
43CLAY&SHLE	646	16.25	8.7	173	39.31	6.4	21	4.76	6.9	485	41.44	10.0	960	41.15	8.8	2285	33.70	8.8
44FELDSPAR	21	23.81	22.8	0	0.00	0.0	0	0.00	0.0	50	36.00	12.1	38	21.05	9.9	109	28.44	13.4
45FLOURSPAR	0	0.00	0.0	91	21.98	3.2	0	0.00	0.0	19	10.53	11.1	8	12.50	5.8	118	19.49	4.7
46GYPSUM	80	12.50	6.8	26	0.00	1.8	0	0.00	0.0	15	0.00	2.6	18	0.00	6.1	139	7.19	5.3
47MAGNESITE	1	0.00	7.1	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	3	0.00	9.6	4	0.00	9.0
48MICA	26	11.54	8.0	0	0.00	0.0	2	100.00	46.6	3	0.00	5.4	31	3.23	7.7	62	9.68	9.0
49PHOSPHATE	272	18.38	10.3	96	14.58	9.0	2	0.00	8.0	23	30.43	10.5	21	19.05	6.1	414	18.12	9.7
50POTASH	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	2	0.00	2.4	0	0.00	0.0	2	0.00	2.4
51PUMICE	20	5.00	7.5	0	0.00	0.0	0	0.00	0.0	2	0.00	14.0	0	0.00	0.0	22	4.55	8.1
52SALT	0	0.00	0.0	1	0.00	1.1	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	1	0.00	1.1
53SODIUM	0	0.00	0.0	10	20.00	2.4	0	0.00	0.0	4	0.00	1.3	0	0.00	0.0	14	14.29	2.1
54SULFUR	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
55TALC,ETC.	31	22.58	12.7	12	8.33	2.5	0	0.00	0.0	10	20.00	6.6	33	33.33	15.1	86	24.42	11.5
56GILSONITE	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0	0	0.00	0.0
58OIL SHALE	0	0.00	0.0	2	50.00	2.8	0	0.00	0.0	2	100.00	4.4	0	0.00	0.0	4	75.00	3.6
59NONMETALS	95	8.42	10.6	60	26.67	8.7	2	0.00	6.5	45	64.44	29.1	304	62.83	28.5	506	48.22	22.7
60SAND&GRAV	3890	12.75	12.3	1	0.00	8.3	19	10.53	18.1	283	22.61	14.8	796	35.43	19.3	4989	16.92	13.6
COL.TOTALS	16408	13.27	9.7	4225	20.45	7.4	275	9.45	8.0	5297	27.79	10.3	7055	28.59	11.8	33260	19.71	9.9

TABLE A-12. -Operation by location breakdown for respirable quartz dust, 1975

	NAME OPR.	UNDERGROUND NUMBER OF— SAMPLES	GETLV	PCT GETLV	OPEN PIT NUMBER OF— SAMPLES	GETLV	PCT GETLV	SAND&GRAVEL NUMBER OF— SAMPLES	GETLV	PCT GETLV	SURFACE NUMBER OF— SAMPLES	GETLV	PCT GETLV	MILL NUMBER OF— SAMPLES	GETLV	PCT GETLV	ALL LOCATIONS NUMBER OF— SAMPLES	GETLV	PCT GETLV
1	SLUSHG	13	6	46.15	0	0	0.00	0	0	0.00	1	1	100.00	0	0	0.00	14	7	50.00
2	MCHMCK	11	5	45.45	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	11	5	45.45
3	HANMCK	2	1	50.00	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	3	1	33.33
4	TIMBER	5	1	20.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	5	1	20.00
5	RCKBLT	4	2	50.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	2	50.00
6	BCKFIL	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
7	BLASTG	6	2	33.33	5	1	20.00	0	0	0.00	2	0	0.00	0	0	0.00	13	3	23.08
8	RCKSAW	2	0	0.00	6	2	33.33	0	0	0.00	19	3	15.79	1	0	0.00	28	5	17.86
9	DRLPER	65	23	35.38	50	14	28.00	0	0	0.00	14	5	35.71	0	0	0.00	129	42	32.56
10	DRLROT	2	2	100.00	68	22	32.35	6	1	16.67	4	2	50.00	0	0	0.00	80	27	33.75
11	DRLDIA	0	0	0.00	1	0	0.00	0	0	0.00	2	1	50.00	0	0	0.00	3	1	33.33
12	LHDELC	29	9	31.03	38	2	5.26	0	0	0.00	15	3	20.00	2	0	0.00	84	14	16.67
13	LHDDIE	94	26	27.66	308	18	5.84	95	10	10.53	84	15	17.86	7	1	14.29	588	70	11.90
14	LHDGAS	0	0	0.00	5	1	20.00	0	0	0.00	15	5	33.33	1	1	100.00	21	7	33.33
15	LHDAIR	5	2	40.00	2	2	100.00	0	0	0.00	1	1	100.00	5	4	80.00	13	9	69.23
16	MINMCH	4	1	25.00	2	1	50.00	0	0	0.00	0	0	0.00	0	0	0.00	6	2	33.33
17	TRKCRW	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
18	CMPCYC	127	38	29.92	0	0	0.00	1	0	0.00	1	0	0.00	0	0	0.00	129	38	29.46
19	CONCRE	79	25	31.65	1	0	0.00	0	0	0.00	3	0	0.00	0	0	0.00	83	25	30.12
20	HOISTG	6	2	33.33	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	7	2	28.57
21	BULLDZ	29	11	37.93	42	8	19.05	7	1	14.29	7	1	14.29	0	0	0.00	85	21	24.71
22	SLURRY	0	0	0.00	1	0	0.00	0	0	0.00	4	2	50.00	0	0	0.00	5	2	40.00
23	GLCLUP	35	10	28.57	29	6	20.69	10	4	40.00	229	88	38.43	39	12	30.77	342	120	35.09
24	GSHPWK	4	0	0.00	1	0	0.00	0	0	0.00	23	2	8.70	1	1	100.00	29	3	10.34
25	WLDING	0	0	0.00	1	1	100.00	0	0	0.00	6	1	16.67	0	0	0.00	7	2	28.57
26	MECHAN	14	1	7.14	11	3	27.27	4	1	25.00	51	12	23.53	4	0	0.00	84	17	20.24
27	CRUSHG	9	5	55.56	42	12	28.57	32	12	37.50	252	92	36.51	3	1	33.33	338	122	36.09
28	GRINDG	0	0	0.00	3	2	66.67	8	3	37.50	117	48	41.03	2	1	50.00	130	54	41.54
29	RSTRTG	0	0	0.00	0	0	0.00	0	0	0.00	12	4	33.33	1	1	100.00	13	5	38.46
30	DYFLTH	1	1	100.00	6	5	83.33	8	5	62.50	42	11	26.19	32	18	56.25	89	40	44.94
31	SIZING	1	1	100.00	11	3	27.27	9	3	33.33	55	26	47.27	45	12	26.67	121	45	37.19
32	CNCTRG	8	0	0.00	3	2	66.67	2	0	0.00	34	5	14.71	16	2	12.50	63	9	14.29
33	CHEMOP	1	1	100.00	0	0	0.00	0	0	0.00	6	0	0.00	0	0	0.00	7	1	14.29
34	SUPPLY	5	0	0.00	7	1	14.29	2	0	0.00	7	1	14.29	4	1	25.00	25	3	12.00
35	TCHSRV	2	0	0.00	3	1	33.33	1	0	0.00	7	1	14.29	1	1	100.00	14	3	21.43
36	ADMINS	8	4	50.00	3	0	0.00	8	1	12.50	22	4	18.18	3	1	33.33	44	10	22.73
37	BAGGER	0	0	0.00	1	1	100.00	0	0	0.00	4	0	0.00	72	45	62.50	77	46	59.74
38	PELLET	0	0	0.00	0	0	0.00	0	0	0.00	4	0	0.00	7	0	0.00	11	0	0.00
39	DREDGE	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
40	JETPRC	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	5	4	80.00	5	4	80.00
	TOTAL	571	179	31.35	650	108	16.62	193	41	21.24	1045	334	31.96	251	106	42.23	2710	768	28.34

TABLE A-13. -Operation by location breakdown for respirable quartz dust, 1976

	NAME OPR.	UNDERGROUND NUMBER OF— SAMPLES	GETLV	PCT GETLV	OPEN PIT NUMBER OF— SAMPLES	GETLV	PCT GETLV	SAND&GRAVEL NUMBER OF— SAMPLES	GETLV	PCT GETLV	SURFACE NUMBER OF— SAMPLES	GETLV	PCT GETLV	MILL NUMBER OF— SAMPLES	GETLV	PCT GETLV	ALL LOCATIONS NUMBER OF— SAMPLES	GETLV	PCT GETLV
1	SLUSHG	43	34	79.07	0	0	0.00	1	0	0.00	1	0	0.00	1	0	0.00	46	34	73.91
2	MCHMCK	9	0	0.00	5	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00	15	0	0.00
3	HANMCK	1	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	0	0	0.00	2	0	0.00
4	TIMBER	6	1	16.67	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	6	1	16.67
5	RCKBLT	17	8	47.06	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	17	8	47.06
6	BCKFIL	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00
7	BLASTG	13	5	38.46	7	2	28.57	0	0	0.00	1	0	0.00	0	0	0.00	21	7	33.33
8	RCKSAW	3	1	33.33	13	4	30.77	0	0	0.00	6	0	0.00	6	1	16.67	28	6	21.43
9	DRLPER	75	29	38.67	198	64	32.32	0	0	0.00	7	1	14.29	0	0	0.00	280	94	33.57
10	DRLROT	31	14	45.16	111	24	21.62	0	0	0.00	5	1	20.00	0	0	0.00	147	39	26.53
11	DRLDIA	5	2	40.00	3	1	33.33	1	0	0.00	0	0	0.00	0	0	0.00	9	3	33.33
12	LHDELC	47	10	21.28	44	5	11.36	9	1	11.11	30	7	23.33	10	3	30.00	140	26	18.57
13	LHDDIE	97	21	21.65	1002	80	7.98	234	25	10.68	222	30	13.51	24	3	12.50	1579	159	10.07
14	LHDGAS	2	1	50.00	36	12	33.33	14	1	7.14	34	7	20.59	8	1	12.50	94	22	23.40
15	LHDAIR	4	1	25.00	1	1	100.00	0	0	0.00	6	0	0.00	2	0	0.00	13	2	15.38
16	MINMCH	3	1	33.33	0	0	0.00	0	0	0.00	2	0	0.00	0	0	0.00	5	1	20.00
17	TRKCRW	7	3	42.86	5	1	20.00	0	0	0.00	1	0	0.00	0	0	0.00	13	4	30.77
18	CMPCYC	168	20	11.90	6	1	16.67	6	1	16.67	4	0	0.00	1	0	0.00	185	22	11.89
19	CONCRE	16	7	43.75	5	0	0.00	2	1	50.00	9	3	33.33	6	1	16.67	38	12	31.58
20	HOISTG	7	1	14.29	16	0	0.00	2	0	0.00	3	0	0.00	2	0	0.00	30	1	3.33
21	BULLDZ	1	0	0.00	128	29	22.66	44	4	9.09	19	2	10.53	7	2	28.57	199	37	18.59
22	SLURRY	0	0	0.00	1	1	100.00	0	0	0.00	1	0	0.00	4	1	25.00	6	2	33.33
23	GLCLUP	69	17	24.64	221	61	27.60	78	28	35.90	341	144	42.23	169	60	35.50	878	310	35.31
24	GSHPWK	1	0	0.00	1	0	0.00	8	0	0.00	24	4	16.67	16	5	31.25	50	9	18.00
25	WLDING	0	0	0.00	1	0	0.00	5	1	20.00	20	12	60.00	4	0	0.00	30	13	43.33
26	MECHAN	23	2	8.70	50	9	18.00	25	2	8.00	130	27	20.77	42	8	19.05	270	48	17.78
27	CRUSHG	28	6	21.43	181	58	32.04	80	23	28.75	496	167	33.67	33	11	33.33	818	265	32.40
28	GRINDG	1	0	0.00	24	6	25.00	5	2	40.00	236	95	40.25	42	21	50.00	308	124	40.26
29	RSTRTG	0	0	0.00	4	3	75.00	3	0	0.00	38	10	26.32	22	7	31.82	67	20	29.85
30	DYFLTH	4	0	0.00	14	6	42.86	29	12	41.38	70	14	20.00	73	31	42.47	190	63	33.16
31	SIZING	2	1	50.00	29	6	20.69	20	4	20.00	53	17	32.08	129	53	41.09	233	81	34.76
32	CNCTRG	0	0	0.00	0	0	0.00	0	0	0.00	37	10	27.03	18	7	38.89	55	17	30.91
33	CHEMOP	0	0	0.00	0	0	0.00	1	0	0.00	6	1	16.67	2	0	0.00	9	1	11.11
34	SUPPLY	6	0	0.00	6	3	50.00	0	0	0.00	6	1	16.67	16	9	56.25	34	13	38.24
35	TCHSRV	4	0	0.00	7	1	14.29	16	2	12.50	13	2	15.38	11	3	27.27	51	8	15.69
36	ADMINS	8	1	12.50	11	0	0.00	13	2	15.38	30	5	16.67	22	9	40.91	84	17	20.24
37	BAGGER	1	0	0.00	17	3	17.65	19	7	36.84	19	5	26.32	219	121	55.25	275	136	49.45
38	PELLET	0	0	0.00	0	0	0.00	0	0	0.00	39	7	17.95	15	5	33.33	54	12	22.22
39	DREDGE	0	0	0.00	0	0	0.00	10	3	30.00	1	0	0.00	0	0	0.00	11	3	27.27
40	JETPRC	0	0	0.00	24	6	25.00	0	0	0.00	0	0	0.00	0	0	0.00	24	6	25.00
	TOTAL	702	186	26.50	2171	387	17.83	626	119	19.01	1910	572	29.95	905	362	40.00	6314	1626	25.75

TABLE A-14. -Operation by location breakdown for respirable quartz dust, 1977

	NAME OPR.	UNDERGROUND NUMBER OF— SAMPLES	UNDERGROUND NUMBER OF— GETLV	UNDERGROUND PCT GETLV	OPEN PIT NUMBER OF— SAMPLES	OPEN PIT NUMBER OF— GETLV	OPEN PIT PCT GETLV	SAND&GRAVEL NUMBER OF— SAMPLES	SAND&GRAVEL NUMBER OF— GETLV	SAND&GRAVEL PCT GETLV	SURFACE NUMBER OF— SAMPLES	SURFACE NUMBER OF— GETLV	SURFACE PCT GETLV	MILL NUMBER OF— SAMPLES	MILL NUMBER OF— GETLV	MILL PCT GETLV	ALL LOCATIONS NUMBER OF— SAMPLES	ALL LOCATIONS NUMBER OF— GETLV	ALL LOCATIONS PCT GETLV
1	SLUSHG	39	14	35.90	0	0	0.00	1	1	100.00	1	1	100.00	0	0	0.00	41	16	39.02
2	MCHNCK	12	2	16.67	2	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	14	2	14.29
3	HANMCK	6	0	0.00	3	1	33.33	1	0	0.00	0	0	0.00	0	0	0.00	10	1	10.00
4	TIMBER	23	2	8.70	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	23	2	8.70
5	RCKBLT	19	1	5.26	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	19	1	5.26
6	BCKFIL	1	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00
7	BLASTG	17	3	17.65	6	1	16.67	0	0	0.00	0	0	0.00	0	0	0.00	23	4	17.39
8	RCKSAW	1	0	0.00	24	0	0.00	0	0	0.00	22	8	36.36	35	2	5.71	82	10	12.20
9	DRLPER	111	28	25.23	277	40	14.44	0	0	0.00	3	0	0.00	0	0	0.00	391	68	17.39
10	DRLROT	30	16	53.33	111	22	19.82	4	0	0.00	3	0	0.00	0	0	0.00	148	38	25.68
11	DRLDIA	7	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	1	100.00	8	1	12.50
12	LHDELC	90	19	21.11	30	0	0.00	9	0	0.00	49	8	16.33	19	4	21.05	197	31	15.74
13	LHDDIE	202	60	29.70	1186	73	6.16	273	21	7.69	206	20	9.71	78	15	19.23	1945	189	9.72
14	LHDGAS	1	0	0.00	26	5	19.23	8	0	0.00	27	5	18.52	12	2	16.67	74	12	16.22
15	LHDAIR	69	24	34.78	1	0	0.00	2	1	50.00	6	1	16.67	6	1	16.67	84	27	32.14
16	MINMCH	2	0	0.00	7	0	0.00	1	0	0.00	0	0	0.00	1	1	100.00	11	1	9.09
17	TRKCRW	7	1	14.29	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	7	1	14.29
18	CMPCYC	292	35	11.99	16	2	12.50	8	1	12.50	14	1	7.14	3	1	33.33	333	40	12.01
19	CONCRE	14	3	21.43	0	0	0.00	0	0	0.00	6	0	0.00	10	1	10.00	30	4	13.33
20	HOISTG	3	0	0.00	3	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	6	0	0.00
21	BULLDZ	0	0	0.00	113	11	9.73	34	2	5.88	11	2	18.18	2	1	50.00	160	16	10.00
22	SLURRY	2	0	0.00	1	0	0.00	3	1	33.33	7	0	0.00	1	1	100.00	14	2	14.29
23	GLCLUP	87	16	18.39	204	46	22.55	132	35	26.52	315	93	29.52	151	45	29.80	889	235	26.43
24	GSHPWK	3	0	0.00	7	2	28.57	9	3	33.33	32	4	12.50	10	2	20.00	61	11	18.03
25	WLDING	5	2	40.00	7	0	0.00	8	1	12.50	28	5	17.86	4	1	25.00	52	9	17.31
26	MECHAN	38	2	5.26	51	8	15.69	41	4	9.76	113	12	10.62	61	4	6.56	304	30	9.87
27	CRUSHG	27	12	44.44	368	109	29.62	77	18	23.38	533	134	25.14	43	5	11.63	1048	278	26.53
28	GRINDG	1	0	0.00	34	5	14.71	12	1	8.33	228	75	32.89	44	18	40.91	319	99	31.03
29	RSTRTG	0	0	0.00	8	1	12.50	4	0	0.00	27	4	14.81	22	2	9.09	61	7	11.48
30	DYFLTH	2	1	50.00	26	4	15.38	22	6	27.27	88	19	21.59	140	40	28.57	278	70	25.18
31	SIZING	1	0	0.00	69	10	14.49	30	3	10.00	53	9	16.98	125	34	27.20	278	56	20.14
32	CNCTRG	3	0	0.00	1	0	0.00	5	0	0.00	31	0	0.00	15	4	26.67	55	4	7.27
33	CHEMOP	1	0	0.00	1	0	0.00	1	0	0.00	16	1	6.25	2	0	0.00	21	1	4.76
34	SUPPLY	10	0	0.00	24	2	8.33	0	0	0.00	20	4	20.00	42	18	42.86	96	24	25.00
35	TCHSRV	5	1	20.00	13	0	0.00	6	1	16.67	25	1	4.00	20	7	35.00	69	10	14.49
36	ADMINS	13	1	7.69	20	1	5.00	16	1	6.25	22	5	22.73	29	8	27.59	100	16	16.00
37	BAGGER	1	1	100.00	55	6	10.91	27	18	66.67	16	5	31.25	335	155	46.27	434	185	42.63
38	PELLET	0	0	0.00	0	0	0.00	0	0	0.00	13	0	0.00	20	3	15.00	33	3	9.09
39	DREDGE	0	0	0.00	3	0	0.00	9	1	11.11	0	0	0.00	0	0	0.00	12	1	8.33
40	JETPRC	0	0	0.00	14	3	21.43	0	0	0.00	0	0	0.00	0	0	0.00	14	3	21.43
	TOTAL	1145	244	21.31	2711	352	12.98	743	119	16.02	1915	417	21.78	1231	376	30.54	7745	1508	19.47

TABLE A-15. -Operation by location breakdown for respirable quartz dust, 1978

		UNDERGROUND			OPEN PIT			SAND&GRAVEL			SURFACE			MILL			ALL LOCATIONS		
	NAME OPR.	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV	NUMBER OF— SAMPLES	GETLV	PCT GETLV
1	SLUSHG	26	7	26.92	0	0	0.00	3	0	0.00	0	0	0.00	0	0	0.00	29	7	24.14
2	MCHMCK	9	1	11.11	9	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	18	1	5.56
3	HANMCK	9	1	11.11	1	0	0.00	1	0	0.00	1	1	100.00	0	0	0.00	12	2	16.67
4	TIMBER	19	4	21.05	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	20	4	20.00
5	RCKBLT	18	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	18	0	0.00
6	BCKFIL	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00
7	BLASTG	26	6	23.08	6	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	32	6	18.75
8	RCKSAW	2	0	0.00	16	0	0.00	0	0	0.00	4	0	0.00	10	2	20.00	32	2	6.25
9	DRLPER	166	24	14.46	259	66	25.48	6	2	33.33	7	1	14.29	0	0	0.00	438	93	21.23
10	DRLROT	47	11	23.40	113	17	15.04	0	0	0.00	6	1	16.67	0	0	0.00	166	29	17.47
11	DRLDIA	8	4	50.00	3	0	0.00	2	0	0.00	0	0	0.00	0	0	0.00	13	4	30.77
12	LHDELC	62	8	12.90	42	1	2.38	14	2	14.29	28	2	7.14	17	9	52.94	163	22	13.50
13	LHDDIE	271	34	12.55	1524	79	5.18	609	31	5.09	213	33	15.49	66	18	27.27	2683	195	7.27
14	LHDGAS	6	1	16.67	37	4	10.81	43	2	4.65	25	4	16.00	17	4	23.53	128	15	11.72
15	LHDAIR	10	4	40.00	5	2	40.00	0	0	0.00	9	0	0.00	0	0	0.00	24	6	25.00
16	MINMCH	1	0	0.00	5	0	0.00	3	0	0.00	3	0	0.00	0	0	0.00	12	0	0.00
17	TRKCRW	2	0	0.00	2	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	0	0.00
18	CMPCYC	191	23	12.04	18	2	11.11	16	4	25.00	2	0	0.00	5	3	60.00	232	32	13.79
19	CONCRE	24	3	12.50	2	0	0.00	0	0	0.00	3	0	0.00	1	0	0.00	30	3	10.00
20	HOISTG	22	3	13.64	11	2	18.18	2	1	50.00	6	1	16.67	0	0	0.00	41	7	17.07
21	BULLDZ	2	1	50.00	114	8	7.02	58	5	8.62	12	1	8.33	3	0	0.00	189	15	7.94
22	SLURRY	4	0	0.00	1	0	0.00	1	0	0.00	8	1	12.50	2	0	0.00	16	1	6.25
23	GLCLUP	69	10	14.49	177	38	21.47	133	28	21.05	259	75	28.96	122	46	37.70	760	197	25.92
24	GSHPWK	9	3	33.33	9	1	11.11	6	0	0.00	42	11	26.19	7	2	28.57	73	17	23.29
25	WLDING	1	0	0.00	6	0	0.00	6	0	0.00	7	1	14.29	1	0	0.00	21	1	4.76
26	MECHAN	29	3	10.34	51	6	11.76	30	4	13.33	95	9	9.47	41	10	24.39	246	32	13.01
27	CRUSHG	55	22	40.00	447	84	18.79	199	29	14.57	617	136	22.04	39	11	28.21	1357	282	20.78
28	GRINDG	4	0	0.00	44	13	29.55	8	0	0.00	170	44	25.88	58	14	24.14	284	71	25.00
29	RSTRTG	0	0	0.00	14	0	0.00	1	0	0.00	16	2	12.50	20	4	20.00	51	6	11.76
30	DYFLTH	3	0	0.00	14	2	14.29	16	5	31.25	64	5	7.81	105	31	29.52	202	43	21.29
31	SIZING	6	1	16.67	87	20	22.99	70	8	11.43	44	6	13.64	112	21	18.75	319	56	17.55
32	CNCTRG	4	0	0.00	7	0	0.00	0	0	0.00	51	11	21.57	26	11	42.31	88	22	25.00
33	CHEMOP	0	0	0.00	0	0	0.00	0	0	0.00	19	2	10.53	3	0	0.00	22	2	9.09
34	SUPPLY	4	0	0.00	10	2	20.00	0	0	0.00	20	3	15.00	32	23	71.88	66	28	42.42
35	TCHSRV	3	0	0.00	3	0	0.00	1	0	0.00	21	1	4.76	6	2	33.33	34	3	8.82
36	ADMINS	7	0	0.00	17	0	0.00	5	1	20.00	18	3	16.67	22	6	27.27	69	10	14.49
37	BAGGER	1	1	100.00	23	6	26.09	13	7	53.85	7	1	14.29	257	111	43.19	301	126	41.86
38	PELLET	0	0	0.00	13	4	30.77	0	0	0.00	27	4	14.81	27	2	7.41	67	10	14.93
39	DREDGE	0	0	0.00	0	0	0.00	5	0	0.00	0	0	0.00	0	0	0.00	5	0	0.00
40	JETPRC	1	0	0.00	18	6	33.33	0	0	0.00	0	0	0.00	0	0	0.00	19	6	31.58
	TOTAL	1121	175	15.61	3108	363	11.68	1252	129	10.30	1805	359	19.89	999	330	33.03	8285	1356	16.37

TABLE A-16. -Operation by location breakdown for respirable quartz dust, 1979

	NAME OPR.	UNDERGROUND NUMBER OF— SAMPLES	UNDERGROUND NUMBER OF— GETLV	UNDERGROUND PCT GETLV	OPEN PIT NUMBER OF— SAMPLES	OPEN PIT NUMBER OF— GETLV	OPEN PIT PCT GETLV	SAND&GRAVEL NUMBER OF— SAMPLES	SAND&GRAVEL NUMBER OF— GETLV	SAND&GRAVEL PCT GETLV	SURFACE NUMBER OF— SAMPLES	SURFACE NUMBER OF— GETLV	SURFACE PCT GETLV	MILL NUMBER OF— SAMPLES	MILL NUMBER OF— GETLV	MILL PCT GETLV	ALL LOCATIONS NUMBER OF— SAMPLES	ALL LOCATIONS NUMBER OF— GETLV	ALL LOCATIONS PCT GETLV
1	SLUSHG	30	7	23.33	0	0	0.00	0	0	0.00	2	2	100.00	0	0	0.00	32	9	28.13
2	MCHMCK	9	0	0.00	6	1	16.67	0	0	0.00	0	0	0.00	0	0	0.00	15	1	6.67
3	HANMCK	1	0	0.00	4	0	0.00	4	1	25.00	2	0	0.00	4	0	0.00	15	1	6.67
4	TIMBER	8	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	8	0	0.00
5	RCKBLT	4	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	4	0	0.00
6	BCKFIL	1	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	1	0	0.00
7	BLASTG	11	3	27.27	2	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	13	3	23.08
8	RCKSAW	3	0	0.00	24	1	4.17	0	0	0.00	5	1	20.00	10	0	0.00	42	2	4.76
9	DRLPER	68	13	19.12	215	53	24.65	8	0	0.00	3	0	0.00	1	0	0.00	295	66	22.37
10	DRLROT	21	1	4.76	155	34	21.94	2	0	0.00	4	1	25.00	1	0	0.00	183	36	19.67
11	DRLDIA	1	0	0.00	5	1	20.00	0	0	0.00	0	0	0.00	0	0	0.00	6	1	16.67
12	LHDELC	63	4	6.35	84	4	4.76	22	2	9.09	19	6	31.58	12	2	16.67	200	18	9.00
13	LHDDIE	165	13	7.88	1547	72	4.65	624	37	5.93	217	13	5.99	65	8	12.31	2618	143	5.46
14	LHDGAS	5	0	0.00	46	1	2.17	13	1	7.69	15	2	13.33	14	1	7.14	93	5	5.38
15	LHDAIR	14	1	7.14	6	1	16.67	0	0	0.00	2	0	0.00	0	0	0.00	22	2	9.09
16	MINMCH	2	0	0.00	14	1	7.14	0	0	0.00	4	0	0.00	1	0	0.00	21	1	4.76
17	TRKCRW	1	0	0.00	1	0	0.00	2	1	50.00	1	0	0.00	0	0	0.00	5	1	20.00
18	CMPCYC	103	4	3.88	18	2	11.11	6	0	0.00	3	1	33.33	0	0	0.00	130	7	5.38
19	CONCRE	9	1	11.11	4	1	25.00	0	0	0.00	0	0	0.00	2	0	0.00	15	2	13.33
20	HOISTG	7	0	0.00	9	1	11.11	0	0	0.00	4	1	25.00	0	0	0.00	20	2	10.00
21	BULLDZ	0	0	0.00	100	8	8.00	69	9	13.04	7	0	0.00	2	0	0.00	178	17	9.55
22	SLURRY	1	0	0.00	3	0	0.00	1	0	0.00	4	1	25.00	3	0	0.00	12	1	8.33
23	GLCLUP	46	5	10.87	285	47	16.49	162	31	19.14	256	85	33.20	118	32	27.12	867	200	23.07
24	GSHPWK	4	0	0.00	9	3	33.33	9	1	11.11	24	5	20.83	11	0	0.00	57	9	15.79
25	WLDING	0	0	0.00	5	0	0.00	4	0	0.00	10	1	10.00	3	2	66.67	22	3	13.64
26	MECHAN	7	0	0.00	40	1	2.50	26	5	19.23	61	7	11.48	21	1	4.76	155	14	9.03
27	CRUSHG	24	1	4.17	567	85	14.99	263	34	12.93	498	112	22.49	40	13	32.50	1392	245	17.60
28	GRINDG	8	1	12.50	26	5	19.23	1	0	0.00	78	6	7.69	42	17	40.48	155	29	18.71
29	RSTRTG	1	0	0.00	10	0	0.00	3	0	0.00	18	3	16.67	29	10	34.48	61	13	21.31
30	DYFLTH	8	3	37.50	24	4	16.67	31	3	9.68	56	3	5.36	101	24	23.76	220	37	16.82
31	SIZING	2	0	0.00	114	13	11.40	62	4	6.45	35	5	14.29	86	30	34.88	299	52	17.39
32	CNCTRG	0	0	0.00	28	5	17.86	1	0	0.00	36	2	5.56	17	4	23.53	82	11	13.41
33	CHEMOP	0	0	0.00	1	0	0.00	0	0	0.00	8	0	0.00	0	0	0.00	9	0	0.00
34	SUPPLY	6	1	16.67	11	1	9.09	2	0	0.00	6	1	16.67	27	5	18.52	52	8	15.38
35	TCHSRV	1	0	0.00	11	1	9.09	2	0	0.00	23	1	4.35	7	2	28.57	44	4	9.09
36	ADMINS	3	2	66.67	12	1	8.33	3	0	0.00	8	2	25.00	10	6	60.00	36	11	30.56
37	BAGGER	0	0	0.00	35	16	45.71	20	5	25.00	5	0	0.00	242	105	43.39	302	126	41.72
38	PELLET	0	0	0.00	16	3	18.75	0	0	0.00	16	3	18.75	16	3	18.75	48	9	18.75
39	DREDGE	0	0	0.00	1	0	0.00	20	1	5.00	2	0	0.00	0	0	0.00	23	1	4.35
40	JETPRC	0	0	0.00	23	5	21.74	3	1	33.33	0	0	0.00	1	0	0.00	27	6	22.22
	TOTAL	637	60	9.42	3461	371	10.72	1363	136	9.98	1432	264	18.44	886	265	29.91	7779	1096	14.09

TABLE A-17. - Operation by location breakdown for respirable quartz dust, 1974-80

	NAME OPR.	UNDERGROUND NUMBER OF— SAMPLES	UNDERGROUND NUMBER OF— GETLV	UNDERGROUND PCT GETLV	OPEN PIT NUMBER OF— SAMPLES	OPEN PIT NUMBER OF— GETLV	OPEN PIT PCT GETLV	SAND&GRAVEL NUMBER OF— SAMPLES	SAND&GRAVEL NUMBER OF— GETLV	SAND&GRAVEL PCT GETLV	SURFACE NUMBER OF— SAMPLES	SURFACE NUMBER OF— GETLV	SURFACE PCT GETLV	MILL NUMBER OF— SAMPLES	MILL NUMBER OF— GETLV	MILL PCT GETLV	ALL LOCATIONS NUMBER OF— SAMPLES	ALL LOCATIONS NUMBER OF— GETLV	ALL LOCATIONS PCT GETLV
1	SLUSHG	153	69	45.10	0	0	0.00	5	1	20.00	5	4	80.00	1	0	0.00	164	74	45.12
2	MCHMCK	51	8	15.69	22	1	4.55	0	0	0.00	0	0	0.00	1	0	0.00	74	9	12.16
3	HANMCK	19	2	10.53	8	1	12.50	7	1	14.29	6	3	50.00	4	0	0.00	44	7	15.91
4	TIMBER	66	8	12.12	0	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	67	8	11.94
5	RCKBLT	62	11	17.74	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	62	11	17.74
6	BCKFIL	2	0	0.00	0	0	0.00	1	0	0.00	0	0	0.00	0	0	0.00	3	0	0.00
7	BLASTG	73	19	26.03	26	4	15.38	0	0	0.00	3	0	0.00	0	0	0.00	102	23	22.55
8	RCKSAW	11	1	9.09	85	7	8.24	0	0	0.00	64	14	21.88	62	5	8.06	222	27	12.16
9	DRLPER	498	123	24.70	1010	243	24.06	14	2	14.29	34	7	20.59	1	0	0.00	1557	375	24.08
10	DRLROT	133	46	34.59	560	121	21.61	12	1	8.33	22	5	22.73	1	0	0.00	728	173	23.76
11	DRLDIA	21	6	28.57	12	2	16.67	3	0	0.00	2	1	50.00	1	1	100.00	39	10	25.64
12	LHDELC	293	50	17.06	240	12	5.00	55	6	10.91	144	29	20.14	60	18	30.00	792	115	14.52
13	LHDDIE	849	163	19.20	5596	329	5.88	1849	127	6.87	955	112	11.73	241	46	19.09	9490	777	8.19
14	LHDGAS	14	2	14.29	150	23	15.33	80	4	5.00	123	23	18.70	52	9	17.31	419	61	14.56
15	LHDAIR	102	32	31.37	15	6	40.00	2	1	50.00	24	2	8.33	13	5	38.46	156	46	29.49
16	MINMCH	12	2	16.67	28	2	7.14	4	0	0.00	9	0	0.00	2	1	50.00	55	5	9.09
17	TRKCRW	17	4	23.53	8	1	12.50	2	1	50.00	2	0	0.00	0	0	0.00	29	6	20.69
18	CMPCYC	881	120	13.62	58	7	12.07	37	6	16.22	25	3	12.00	9	4	44.44	1010	140	13.86
19	CONCRE	144	41	28.47	12	1	8.33	2	1	50.00	21	3	14.29	19	2	10.53	198	48	24.24
20	HOISTG	45	6	13.33	39	3	7.69	4	1	25.00	14	2	14.29	2	0	0.00	104	12	11.54
21	BULLDZ	32	12	37.50	504	68	13.49	214	21	9.81	56	6	10.71	14	3	21.43	820	110	13.41
22	SLURRY	7	0	0.00	7	1	14.29	5	1	20.00	24	4	16.67	10	2	20.00	53	8	15.09
23	GLCLUP	308	58	18.83	919	199	21.65	526	131	24.90	1436	510	35.52	601	196	32.61	3790	1094	28.87
24	GSHPWK	21	3	14.29	30	8	26.67	32	4	12.50	153	27	17.65	47	11	23.40	283	53	18.73
25	WLDING	6	2	33.33	20	1	5.00	23	2	8.70	71	20	28.17	13	3	23.08	133	28	21.05
26	MECHAN	111	8	7.21	203	27	13.30	129	18	13.95	461	71	15.40	169	23	13.61	1073	147	13.70
27	CRUSHG	143	46	32.17	1620	358	22.10	653	116	17.76	2442	662	27.11	161	42	26.09	5019	1224	24.39
28	GRINDG	14	1	7.14	131	31	23.66	34	6	17.65	850	278	32.71	188	71	37.77	1217	387	31.80
29	RSTRTG	1	0	0.00	36	4	11.11	13	0	0.00	111	23	20.72	96	24	25.00	257	51	19.84
30	DYFLTH	18	5	27.78	84	21	25.00	109	33	30.28	330	56	16.97	455	145	31.87	996	260	26.10
31	SIZING	12	3	25.00	310	52	16.77	197	26	13.20	259	75	28.96	498	151	30.32	1276	307	24.06
32	CNCTRG	15	0	0.00	39	7	17.95	8	0	0.00	224	59	26.34	92	28	30.43	378	94	24.87
33	CHEMOP	2	1	50.00	2	0	0.00	2	0	0.00	55	4	7.27	7	0	0.00	68	5	7.35
34	SUPPLY	31	1	3.23	59	9	15.25	6	2	33.33	59	10	16.95	123	57	46.34	278	79	28.42
35	TCHSRV	15	1	6.67	37	3	8.11	26	3	11.54	89	6	6.74	45	15	33.33	212	28	13.21
36	ADMINS	39	8	20.51	64	2	3.13	48	6	12.50	102	19	18.63	86	30	34.88	339	65	19.17
37	BAGGER	3	2	66.67	131	32	24.43	82	38	46.34	51	11	21.57	1133	543	47.93	1400	626	44.71
38	PELLET	0	0	0.00	29	7	24.14	0	0	0.00	99	14	14.14	85	13	15.29	213	34	15.96
39	DREDGE	0	0	0.00	4	0	0.00	44	5	11.36	3	0	0.00	0	0	0.00	51	5	9.80
40	JETPRC	1	0	0.00	79	20	25.32	3	1	33.33	0	0	0.00	6	4	66.67	89	25	28.09
	TOTAL	4225	864	20.45	12177	1613	13.25	4231	565	13.35	8329	2063	24.77	4298	1452	33.78	33260	6557	19.71

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